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Physical Qualifications of the Navy's Applicants*

By Lieutenant Commander H. D. Templeton
Medical Corps, United States Navy
Navy Recruiting Station, Indianapolis, Indiana

EACH year thousands of young men throughout the United States visit the Navy recruiting and sub-recruiting stations for the purpose of enlisting in the Navy. These young men are a fairly representative group of our young adults between the ages of seventeen and twenty-five years, who for the most part are seeking employment and an opportunity to learn a trade which has been denied them because of the existing economic conditions of the past few years.

The present method of handling all Navy applicants is known to us as "selective recruiting," which is a rather elaborate system of various examinations and qualifying tests, substantiated by references which attest to the applicant's mental and moral attributes as well as to his industry and ability. In brief, then, it is our objective to maintain the peace time strength of the Navy by recruiting each year several thousands of young men who are average or above in all the qualities so earnestly desired in our sailormen.

You doubtlessly appreciate that like all systems with fairly rigid standards, our rejections far exceed our acceptances; however, these rejected applicants are in no manner to be regarded as physically handicapped for the military or naval services in the event of a national emergency. On such an occasion they could perform very necessary and important duties compatible with their physical limitations; therefore, these young men who fail to meet the physical standards of a peace time organization interest us very much because they are the potential source of personnel expansion in meeting the demands of an emergency. A discussion of the military-navy importance of this subject can be of little more than passing interest to the physician in civilian practice; however, the results of our examinations based on the standards for acceptance into the Naval Service contain several facts that may interest those of you who are actively engaged in the application of preventive medicine measures to our public school system.

The physical standards by which our applicants are accepted or rejected are not hard and fast rules of weights and measures, but rather, a

* The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

summary of those physical qualities most desired in our sailormen that they may perform frequent arduous and strenuous duties without impairment of health and naval efficiency. Such physical qualities have become more or less standardized because they represent corrections of our past failures to reduce our mortality and morbidity rates, and separations from the service arising from physical disabilities. Thus when we learned that the diseases most frequently encountered in the Naval Service were more prone to attack those individuals with certain physical handicaps, we found that our successes became proportional to the application of these standards rather than an adherence to a list of "cut and dried" physical standards and rules that have not evolved from our own department of vital statistics.

There is nothing of the unusual in our physical examinations; they must be most thorough because we examine young men who have no complaints nor reasons to believe they are ill and, frequently, it is a game in which the applicant "hides" and the examiner "seeks." This was well demonstrated in the case of a young man I recently examined who had an artificial eye. You may readily appreciate that our examinations resolve themselves into an examination of each system, and with such findings as we are able to obtain, we then decide whether evidence of a former disease, a malformation, or impaired development limits the applicant's physical ability to perform all the duties of a sailor. Will he be an economic asset or a liability requiring frequent treatment, absenting him from those duties for which he was enlisted?

Where weights and measures are desired in appraising physical proportions, our standards are most liberal as you will appreciate in the following brief resume.[1]

A minimum vision of 15/20 in each eye (unaided by glasses), as determined by the Snellen's twenty-foot test letters.

Color perception is determined by requiring the applicant to read correctly various groups of Stilling's test plates.

Auditory acuity must be 15/15 by whispered voice.

The minimum height is sixty-four inches with a maximum of seventy-six inches.

Our tables for height, weight, and chest measurements, as shown on the following page, are intended for the guidance of the examiner.

No recruit will be accepted unless he has at least twenty sound teeth, and of these not less than four opposed incisors and four opposed molars (2 sets of each). Teeth permanently filled are considered sound. Replacements by bridges are not considered sound teeth. Abutments (natural teeth to which bridges are attached) and crowned teeth may be counted as sound teeth only when they appear in good condition and

[1] *Manual of the Medical Department, United States Navy* (1927), Chapter II, "Physical Examinations."

supported by healthy tissue. Teeth are considered unserviceable when involved with pyorrhea pockets, extensive caries, or apical infection. Marked overbite, prognathism, or other oral deformities causing lack of occlusion shall be considered a cause for rejection.

Hernia or a tendency to hernia is always ruled out.

Age	Height	Weight	Chest at Expiration	Expansion Required
17	Under 65 inches	110	30	2
	65 and under 68	114	31	2
	68 and under 70	119	31½	2
	70 and under 72	125	32	2½
	72 and over	130	32	2½
19	Under 65 inches	120	32	2
	65 and under 68	124	32½	2
	68 and under 70	129	33	2½
	70 and under 72	135	33½	2½
	72 and over	140	33½	2½
21	Under 65 inches	128	32	2
	65 and under 68	136	33	2
	68 and under 70	148	33½	2½
	70 and under 72	152	34	2½
	72 and over	162	35	2½

Venereal infections and malformations of the genitalia are causes for rejection.

Hands, feet, bones, and joints are subjected to close scrutiny to rule out all diseases and impairment of function resulting from injuries and malformations. Flat transverse and longitudinal arches of the feet are not acceptable.

The detection of mental and nervous diseases is perhaps the most difficult part of the examination of applicants. Every effort is made to reject the mentally deficient and those showing evidence of serious nervous affections.

Of considerable interest are the results of several thousands of physical examinations conducted at our recruiting stations as reported by the Surgeon General of the Navy in his annual reports "Statistics of Diseases and Injuries in the United States Navy":[2]

TABLE I

	1933	1934	1935	Totals
Applicants examined	42,948	88,718	91,449	223,115
Applicants rejected	30,900	66,419	67,999	165,318
Applicants accepted	12,048	22,299	23,450	57,797
Per cent accepted	28	25.1	25.6	25.9

[2] "Statistics of Diseases and Injuries in the United States Navy." Surgeon General's annual reports for the years 1933, 1934, and 1935.

The percentages of acceptance might be considered relatively high in view of the fairly rigid physical examination each applicant received, but on the other hand, it is interesting to note that in each of these three years, ten physical defects were responsible for over 69 per cent of our 165,318 rejections. They are quoted in Table II from the Surgeon General's annual reports in their order of frequency:[2]

TABLE II

1933		1934		1935	
1. Def. teeth	5,083	Def. teeth	10,502	Def. teeth	11,586
2. Def. vision	3,421	Def. vision	8,571	Def. vision	8,314
3. Flat foot	2,486	Flat foot	5,441	Abnorm. of teeth	5,584
4. Def. phys. dev.	1,935	Abnorm. of teeth	5,396	Flat foot	5,341
5. Underweight	1,846	Def. phys. dev.	4,300	Def. phys. dev.	4,588
6. Heart affections	1,631	Color blindness	3,158	Underweight	2,899
7. Color blindness	1,609	Underweight	3,136	Color blindness	2,783
8. Abnorm. of teeth	1,294	Heart affections	2,429	Pyorrhea	2,558
9. Pyorrhea	1,017	Pyorrhea	1,792	Heart affections	1,623
10. Varicocele	833	Varicocele	1,705	Varicocele	1,614
Total	21,155		46,430		46,890
			Grand Total.....		114,475

Defective teeth, for several years, have been our applicants' greatest handicap; as a matter of fact, the vast majority of those whom I have rejected for this defect had dental pathology in far greater proportions than our standards suggest. If we consider all dental conditions (defective teeth, pyorrhea, and abnormalities of the teeth) as one group, the three years' total amounts to 44,812 rejections which accounts for slightly more than 27 per cent of *all* rejections. Defective vision (20,306) accounts for 12 per cent, flat foot (13,268) 8 per cent, and defective physical development (10,823) 6 per cent. These imposing totals and percentages suggest to me that, in many instances, we are rejecting a type of applicant whose general physical development is definitely below the average. While the Navy's age limits for first enlistment are seventeen to twenty-five years, by far the greatest majority of our applicants are under twenty-one; an age at which nutritional and developmental defects begin to assume very definite economic values.

In order that a clearer picture might be presented of these applicants whose physical defects place them in the group just described, I turned to my files for a survey of the records of 2,263 applicants I had examined. There was no particular reason for selecting this number, but it so happens that these cases were examined over a recent period of time

Applicants examined	2,263	
Applicants rejected	1,764	
Applicants accepted	499	or 22 per cent.

[2] *Ibid.*

Continuing my inspection of these records, I noted that 1,228 or 69 per cent of all rejections (1,764) were distributed amongst seven groups, namely:

TABLE III

1. Errors of refraction	256	5. Flat foot	130
2. Defective physical development	248	6. Color blindness	85
3. Defective teeth	237	7. Hernia	39
4. Abnormalities of the teeth	233		
			1,228

Since this group of 1,228 rejections not only represents 69 per cent of my losses, but also seven of the ten causes for rejection noted in Table II, it should be subjected to further analysis in an effort to determine as nearly as possible how much under nourishment and faulty development exist amongst this number.

Table IV deals with these 1,228 cases in a more detailed manner. One notes that 224 have but one major defect and were it possible to correct that error successfully, they would qualify without further difficulties. However, the remaining 1,004, which is 44 per cent of all examined (2,263), present an entirely different problem, for not only has each of these young men a defect of major importance, but also various accompanying defects, several of which are equally as important as the one given first consideration. For example, in the 168 cases of defective teeth, there were 58 instances of flat foot, 34 of defective physical development, 25 of malocclusion, and so on through the list of "other defects" under this heading, which I believe clearly illustrates the fact that these young men are not only below our physical standards, but also below the generally accepted average for this age group.

Those applicants whose physical qualifications are quite the lowest of all types are best described as "defective physical development" and I find in this survey that they represent slightly more than 10 per cent of those examined. In this group, under nourishment, retarded and insufficient development are represented in the highest degree; not only are they quite definitely not physically qualified for the Naval Service, but one might be justifiably concerned over their ability to obtain gainful employment in those industries where a fair degree of health, robustness, and general physical development is required.

I believe one's conclusions and final impressions of these 1,004 applicants may be gathered from the totals where it is noted that fairly high incidences of defective teeth, underweight, malocculsions, and defective physical development appear—all of which are in addition to one of seven major causes for rejection. In a survey of this sort, it is manifestly impossible to show the extent or degree to which any defect exists; however, I believe the fact that they are present in such alarming numbers is most significant, and leaves much to be wished for in the physical qualifications of these young men.

TABLE IV

THE SEVEN MAJOR PHYSICAL DEFECTS RESPONSIBLE FOR 69 PER CENT OF REJECTIONS

Defects	Defective Physical Development	Errors of Refraction	Defective Teeth	Abnormalities of Teeth	Flat Feet	Color Blindness	Hernia	Totals
Total Number	248	256	237	233	130	85	39	1,228
With one major defect	0	36	69	63	28	15	13	224
With other major defects	248	220	168	170	102	70	26	1,004
THE ACCOMPANYING "OTHER MAJOR PHYSICAL DEFECTS"								
Varicocele	26	20	13	19	8	3	4	93
Pituitary condition	0	2	2	1	1	0	0	6
Tonsillitis, acute and chronic	26	22	21	16	15	11	15	126
Otitis media—ext. and int.	5	2	2	0	2	0	0	11
Color blindness	8	8	7	10	0	..	0	33
Errors of refraction	32	..	9	20	9	6	4	80
Abnormalities of genital organs	18	8	18	19	2	0	1	66
Enuresis	6	1	2	1	1	0	2	13
Curvature of spine	28	10	8	4	3	2	1	56
Flat and weak foot	61	67	58	47	..	19	8	260
Hammer toes	4	5	6	4	1	0	0	20
Defective speech	5	1	3	6	0	0	0	15
Asthma	2	0	1	0	1	2	0	6
Skin diseases	3	13	20	18	6	3	1	64
Hernia, or tendency to	8	12	5	10	5	8	..	48
Defective physical development	..	41	34	32	11	14	5	137
Deformities	37	10	6	7	3	4	1	68
Obesity	0	2	6	3	1	1	0	13
Height, under	5	5	2	0	1	1	0	14
Weight, 10 per cent under standard	175	38	12	10	18	19	3	275
Height and weight, under	7	3	0	0	0	2	0	12
Abnormalities of teeth	68	47	25	..	29	14	4	187
Defective teeth	109	75	..	64	30	25	10	313
Pyorrhea	28	15	10	23	7	3	1	87
Totals	661	407	270	314	154	137	60	2,003

The number of applicants represented in my survey are far too few to draw an analogy between them and the rejected applicants noted in Table I; nor can I assume that my 44 per cent (1,004) are of the same type physically as those listed in Table II. However, Table II does not present a true and complete picture of those applicants' physical defects, and I believe there is much basis for the assumption that similar findings (as shown in Table IV) *might be* revealed were one to subject their physical records to a more searching analysis.

CONCLUSIONS

The application of certain preventive measures which we term "selective recruiting" have materially reduced medical losses, and for this reason our physical standards have high economic values.

Adherence to these standards over the three years' period reported resulted in a 25 per cent acceptance.

Ten diseases or physical defects were responsible for 69 per cent of our rejections.

A more searching analysis of 2,263 cases studied at this station reveals 1,764 found not physically qualified for the Naval Service. Of the latter number, 1,228 were rejected for one of seven major physical defects; and of this group, 1,004 or 44 per cent of the 2,263 examined, had several outstanding defects of which defective teeth, underweight, flat foot, malocclusion, and defective development occurred with the greatest frequency.

As hundreds of these young men submit to our examinations each year, our findings reveal much to be desired in many of those whose physical development is below the usually accepted standards. Frequently one wonders how much of this pathology might have been prevented in their more formative years, also how much they will have corrected within the next ten or fifteen years, and to what extent will their physical defects prevent them from obtaining and holding gainful employment in competition with those who are better equipped physically.

A Further Study of the Analysis of Movement on the Basis of Latent Times and Variabilities

By Frederic Scripps Beebee
Director of Intramural Athletics
State University of Iowa

IT HAS been customary to group movements resulting from neural activity at the spinal level as reflex while those resulting from activity involving chiefly the cortex are designated as voluntary. Lapp pointed out that the reflex-will concept is more nearly a philosophical method of disposing of the question than it is an explanation, and a more scientific method of classifying movements is needed.[1]* Studying the latency and variability of the movement of the intact gastrocnemius muscle of human subjects in situations where the portion of the nervous system involved could be classified as coming under one of the three traditional categories of reflex action, simple reaction, and complex reaction, Lapp found it possible to classify movements by comparing the latent times and variabilities of the responses to various situations.

The investigation presented here is based on data obtained by the same technique employed by Lapp but involving the use of a different neuro-muscular mechanism. The latency of the contraction of the quadriceps femoris muscle involved in the knee-jerk, was used as the basic movement representative of the reflex response. So as to have the same final-common-path for all experiments the contraction of the rectus femoris muscle was used as the response. The effector mechanism was held constant throughout the experiment, while the stimulus pattern was varied.

Since this experiment was set up with the same objective used by Lapp, the presentation of the data is made to conform very closely to his. This is done so that the data obtained in both experiments can be fitted into the movement classification concept more easily.

REVIEW OF LITERATURE

Although there are many published reports dealing with the knee-jerk, only those having a direct bearing on the problem under investigation are reviewed.

This paper is from the Department of Physiology, College of Medicine, State University of Iowa. This is an excerpt from a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Graduate School, State University of Iowa.

* Indices refer to numbered Bibliography at the end of this article.

Jolly has shown that the time required for the execution of the patellar reflex is distributed among the following:[2] the latency of the receptors; the time of conduction from the vastus internus and part of the crureus divisions of the quadriceps to the cord by the anterior crural nerve and back by the same nerve trunk to the muscle; the latent period of the electrical change (or thickening) of the muscle; and the time occupied at the synapse.

The literature contains a number of studies of resistances in the various parts of the nervous system as shown by latent times.

Fearing in his review of the early experiments tabulates the following latent times secured for the knee-jerk by the muscle-thickening method.[3]

		Time in milliseconds			Time in milliseconds
Tschirjew	1879.....	58-61	James	1880.....	25
Gowers	1879.....	15-90	Eulenberg	1882.....	24
Brissaud	1880.....	50	De Watteville	1882.....	20
ter Meulen	.....	35-90	Rosenheim	1884.....	31-33
Waller	1880.....	30-40	Jendrassik	1894.....	23

Other and more recent investigators report the following reflex times for the knee-jerk using muscle thickening as the index of response.

Dodge[4]	32.1	Wendt[6]	30-50
Nystrom[5]	32		

By means of the action current method the following latent times are reported:

Wertheim-Salomonson[7] ..	10.0	Dodge[4]	14.0
Snyder[8]	11.3	Travis and Hunter[10].....	19.4
Hoffman[9]	19-23	Nystrom[5]	19.4
Jolly[2]	20.5-22.7		

Dodge has given the latency of the gross movement of the reflex as 52.5 milliseconds with a mean variation of 2.7.

No information was obtained from the literature regarding the reaction time for the movements employed in this study.

In order to investigate the effect of resistance and variability in the pathway leading to a common response mechanism, the latent times of four responses were studied and compared. The responses investigated were: first, the thickening of the rectus femoris muscle on electrical stimulation of the motor point; second, the reflex time of the knee-jerk; third, the thickening of the rectus femoris muscle at a given light stimulus (simple reaction time); and fourth, the muscle-thickening response to a light stimulus in a choice situation (choice reaction time).

APPARATUS EMPLOYED

The experiment required the development of three stimulating units, and a recording device for measuring muscle-thickening latency. The separation of the patellar reflex into components of muscle-thickening latency and conduction latency required apparatus for recording action

currents. A comparison of the muscle thickening with gross reflex latency necessitated provision for recording the movements of the leg. Each piece of apparatus is discussed separately.

Muscle-thickening Latency.—The arrangement of the apparatus for measuring muscle-thickening latency is shown in Fig. 1. In order to stimulate the muscle directly, two electrodes covered with canton flannel

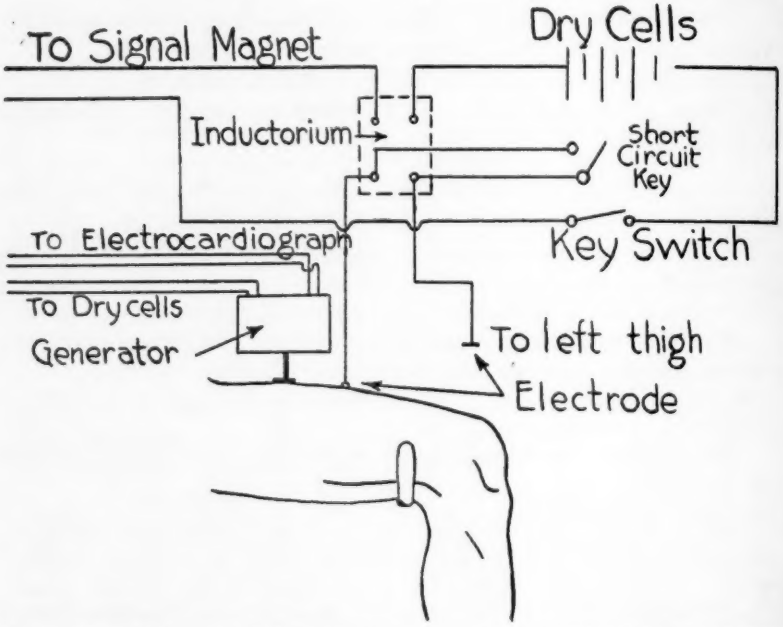

FIG. 1. The arrangement of the apparatus for measuring muscle-thickening latency.

and moistened with a saturated saline solution were employed. One of them, consisting of a copper ball ¼ inch in diameter, was placed over the motor point of the muscle. The other, a brass plate 1 by 1¾ inches was placed on the opposite thigh away from motor points. The electrodes were connected to the secondary of an inductorium. The make stimuli were avoided by means of the short circuit key. In order to record the time of the application of the stimulus a signal magnet was placed in series with the stimulus key and three dry cells. The signal magnet was placed in front of a recording camera which will be described later.

In order to detect the beginning of the muscle thickening, the special generator described by Lapp was used.* The generator consists of a steel core suspended in a soft iron cylinder from a transverse iron base. About 200 turns of No. 16 insulated copper wire were wound on the bottom of

* Where the apparatus used in this experiment is identical with that used by Lapp, *op. cit.*, a description is included but figures are omitted.

the core. These turns of wire terminated in two connections on the base. This constituted the field coil. In order to magnetize the steel core, a 110-volt D.C. current was passed through the coil at frequent intervals. When the coil was in use, two dry cells were connected through the field in order to increase its magnetic power.

A light movable coil consisting of 150 turns of No. 34 insulated copper wire wound on a cardboard spool was suspended from the open end of the cylinder over the field core by means of four rubber bands. The ends of the wire wound on the spool terminated in two connections placed on the base. The sensitivity of the arrangement was proved by the fact that the slightest movement of this coil generated sufficient electricity for detection by a string galvanometer.

The generator was applied to the muscle as shown in Fig. 1. A small piece of thin copper was attached to a light aluminum rod. The copper plate was attached to the rod so that it was free to adapt itself to the muscle. The generator was placed in such proximity to the muscle that, when the rod was placed between the muscle and the generator, a slight tension was placed on the movable coil.

The string galvanometer employed was a standard Cambridge type used in connection with the electrocardiograph. In order to adapt it to our problem some modifications were necessary.

In order to produce ordinate time lines of 1/100 sec. it was necessary to replace the 5-spoked wheel on the synchronous motor timer with one containing 20 spokes. The twentieth spoke was omitted so as to facilitate reading long records.

The camera was altered to permit the use of 35 mm. Eastman recording paper instead of the standard electrocardiograph width. This was done by placing a steel disc guide on the shaft in the magazine. The guide served to cause the paper to be drawn straight past the lens in the aperture of the camera.

It was also found necessary to increase the speed of the camera from 13 to 150 R.P.M. This was done by a system of belts and pulleys.

In order to record muscle-thickening time, the signal magnet in series with the stimulus key was placed in front of the aperture of the camera so that the shadow of the stylus fell near one edge of the paper. The galvanometer string was focused on the paper in close proximity to the stylus. When the camera was running at full speed, the lens was opened at the same time the clutch was engaged. The camera was kept in operation until the muscle had responded to the stimulus. The latent time of the muscle thickening was determined by counting the ordinates on the paper, each representing 10 milliseconds. A sample record is shown in Fig. 2.

Patellar Reflex Latency.—The patellar reflex was elicited by striking the patellar tendon a sharp blow by means of a hammer adapted for this

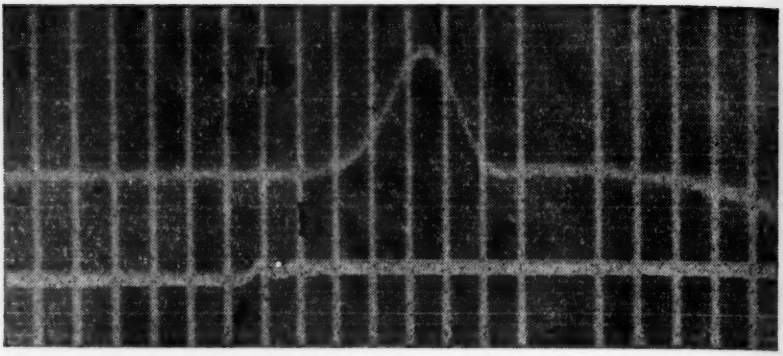

FIG. 2. A record of muscle-thickening latency. *A* the stimulus and *B* the response.

purpose. The hammer is arranged with a movable head set in a rubber plug so that the instant the tendon is struck a circuit containing a signal magnet and a dry cell is closed (Fig. 3). The signal magnet stylus is placed in front of the camera as previously described.

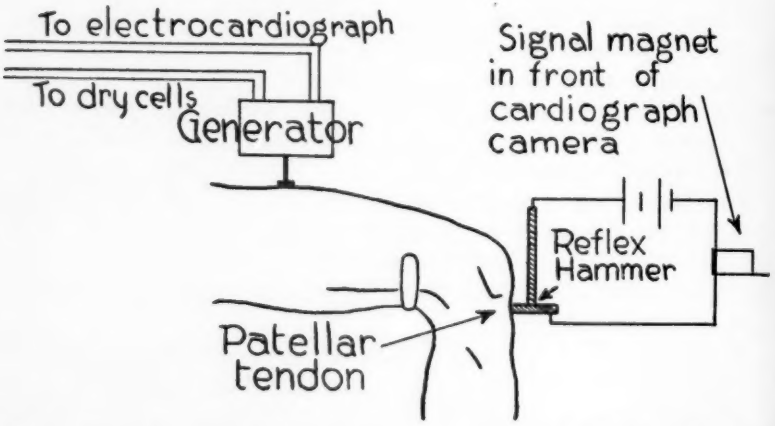

FIG. 3. The arrangement of the apparatus for measuring patellar tendon reflex time.

The beginning of the patellar reflex response is measured by means of the muscle-thickening technique already described. The latent time for the reflex is calculated in the same manner as the latency of muscle thickening. A sample record is shown in Fig. 4.

Simple Reaction Time.—The simple reaction consisted of responding to a single light stimulus by contracting the rectus femoris muscle. A switch is connected in series with a six-volt storage battery, two dry cells, the back magnet on a Dunlap chronoscope, and a six-volt pilot bulb. Simultaneously with the showing of the light, the dial hand on the

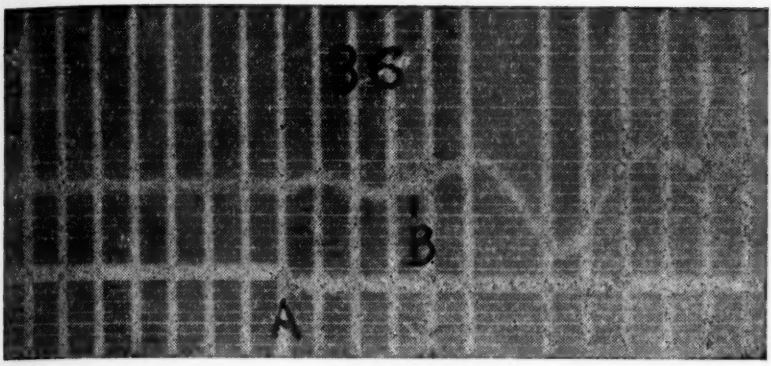

FIG. 4. A record of patellar tendon reflex time. *A* the stimulus and *B* the response.

chronoscope is started. The subject responds to the light as quickly as possible by contracting the rectus femoris muscle which stops the chronoscope.

The arrangement of the apparatus for stopping the chronoscope by the thickening of the gastrocnemius muscle consists of a tambour *A*, Fig. 5, connected by a rubber hose to a pneumatic reaction key. The air column contained a T-tube with a slow-leak arrangement so that the column of air was always adjusted to the surrounding air pressure. The pneumatic switch was connected through a six-volt storage battery to a relay. Since, when the muscle was in a resting state, the pneumatic

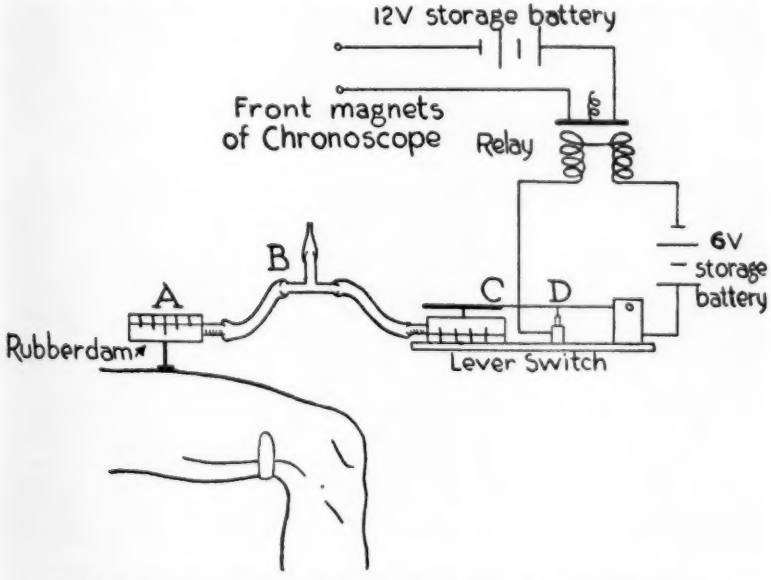

FIG. 5. The arrangement of the apparatus for measuring reaction time.

switch was closed, the relay circuit was also closed. As soon as the muscle began to thicken, the relay circuit was broken, which closed a twelve-volt storage battery circuit to the front chronoscope magnet, thus stopping the dial hand instantly. It will be remembered that the chronoscope was started by the stimulus key. The simple reaction time is read from the chronoscope dial.

Choice Reaction Time.—In this part of the experiment the stimulus pattern consisted of a bank of four lights. The subject was instructed to respond to light 4, but only when it was preceded by lights 3 and 1 in the order named. The stimulus pattern was light 3, 1, and 4. In order to avoid starting the chronoscope when false sequences were given, light 4 was in two circuits, one which started the chronoscope and one which did not. The procedure for starting the chronoscope when the stimulus was given and for stopping it by the thickening of the muscle was the same as described for the simple reaction time.

Action Currents.—The latency of the patellar reflex as expressed by action currents was obtained as follows: Action current electrodes were placed, one on either side of the motor point of the rectus femoris muscle, about one-half inch apart. The electrodes were attached to the string of the galvanometer. When the apparatus was in place, the camera was started and the tendon struck a sharp blow with the reflex hammer previously described. A sample action current record is shown in Fig. 6.

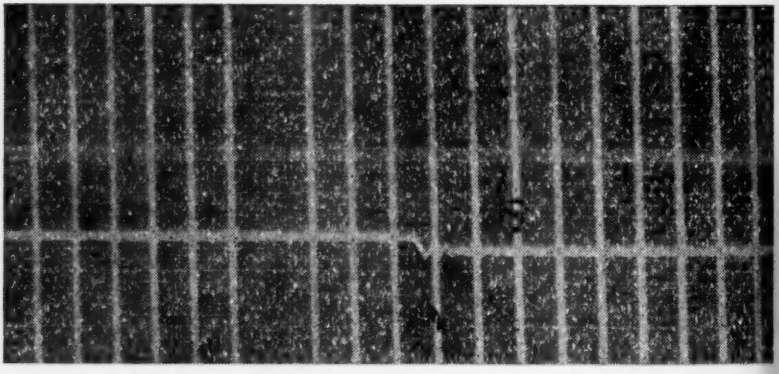

FIG. 6. An action current record. *A* the stimulus and *B* the response.

Gross Movement Latency.—In order to record gross movement muscle latency the rod used for connecting the muscle to the generator previously described was attached to the subject's ankle. The generator was fastened to a stand and placed in such proximity to the ankle that the slightest movement activated the generator, which was in series with the string of the galvanometer. The arrangement of the apparatus is

shown in Fig. 7. The rectus femoris muscle was activated through its motor point as described in the discussion of muscle-thickening latency

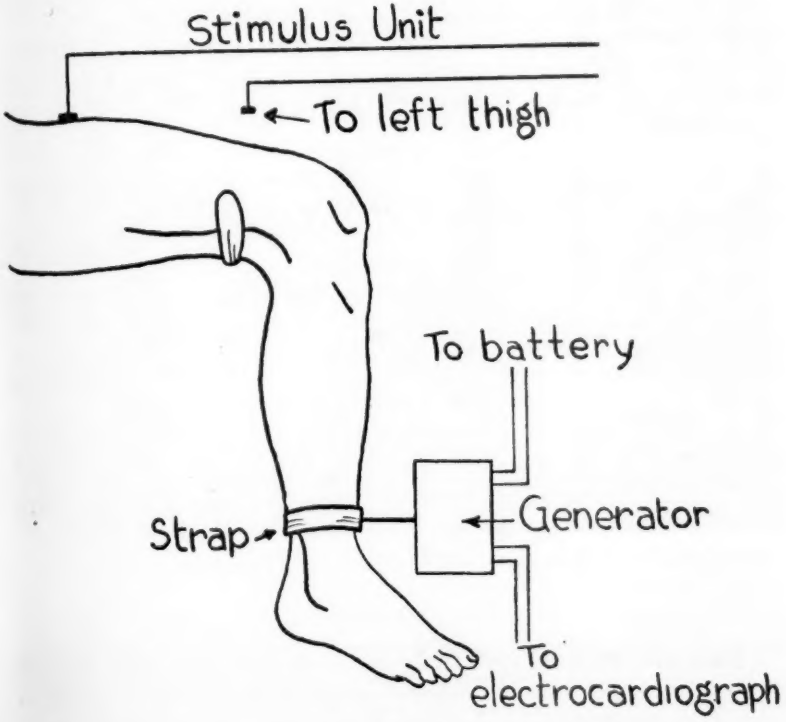

FIG. 7. The arrangement of the apparatus for measuring gross reflex time.

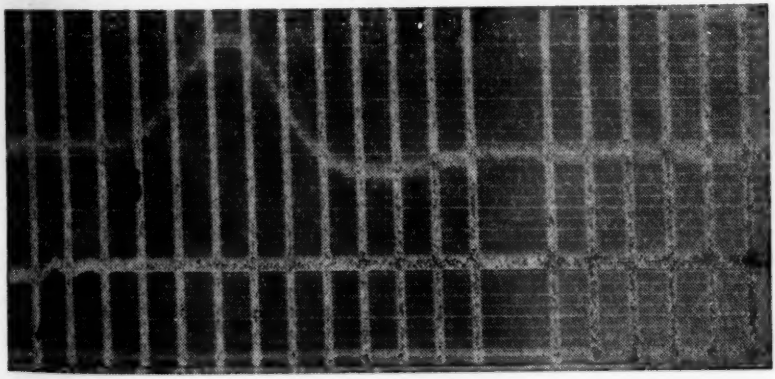

FIG. 8. This is a record of gross movement latency. *A* the stimulus and *B* the response.

and the records were made in the same way. A sample record of gross movement latency is shown in Fig. 8.

Gross Reflex Time.—In order to record gross reflex time in the patellar reflex the generator was left in the same position as it was when gross muscle latency was measured. The reflex was elicited by striking the patellar tendon a sharp blow with the reflex hammer. The records were made the same as in muscle-thickening reflex time. A sample record is shown in Fig. 9.

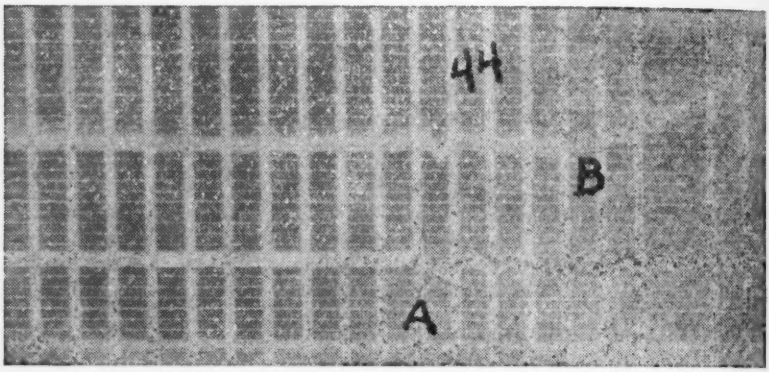

FIG. 9. This is a record of gross reflex latency. *A* the stimulus and *B* the response.

THE DATA

Data were collected from thirty normal male subjects ranging in age from 18 to 35 years. Seven different latencies were studied, each being considered separately.

1. *Muscle-Thickening Latency.*—When the subject came to the laboratory, he assumed a comfortable sitting position on a padded table with his leg hanging over the edge. When the apparatus was adjusted to him, records of his muscle-thickening latency were recorded. In all of the experiments, the right leg was used. It was intended to have 15 records from each subject, since other investigators in this laboratory have proved that number to be sufficient to establish a reliable mean. Due to photographic difficulties the number of readable records was reduced in some cases. The mean latent time of the muscle thickening after electrical stimulation of the motor point was found to be 19.4 millisecs. with a standard deviation of 4.0.

2. *The Latent Time of the Patellar Reflex Measured by Muscle-Thickening.*—Without changing the position of the subject or readjusting the recording apparatus, the patellar tendon reflex was elicited, the beginning of the thickening of the rectus femoris muscle being used as the point of reference. The mean reflex latency by this method was found to be 38.8 millisecs. with a standard deviation of 5.4.

3. *Gross Movement Latency.*—The latent time of the rectus femoris muscle thickening was measured with the first movement of the leg used as the index of response. The subject remained in the same position as in the muscle-thickening experiment. The apparatus was adjusted to the ankle as previously described. The mean latent time for the movement of the leg after the motor point of the rectus femoris muscle was stimulated was 27.1 millisecs. with a standard deviation of 3.9.

4. *The Latent Time of the Patellar Reflex as Shown by the Leg Movement.*—While the subject was sitting on the edge of the table in the usual manner with the generator attached to the ankle, the patellar tendon was struck a sharp blow. Records were made of the gross movement latency of the patellar reflex. The mean latent time of the reflex was found to be 46.8 millisecs. with a standard deviation of 4.9.

5. *The Latent Time of the Patellar Reflex as Measured by Action Currents.*—With the subject remaining in a sitting position the stimulating electrodes were replaced by action current electrodes. Action currents set up in the rectus femoris muscle, by striking the patellar tendon a sharp blow, were recorded. The mean reflex time was found to be 18.8 millisecs. with a standard deviation of 4.4.

6. *Simple Reaction Time.*—In this part of the experiment the subject sat on the table and the apparatus was adjusted to him as previously described. The light stimulus was placed in full view in front of him. The chronoscope was placed in an adjoining room with the door closed during the experiment. As an added precaution against distracting noises, a water tap in the room was allowed to run.

When all was in readiness, the subject was directed to respond by extending the leg as quickly as possible after seeing the light stimulus. The subject was informed that he would be given the signal "ready." This served as a warning signal. The interval between the warning signal and the stimulus was varied, to avoid the formation of a response habit. The general aim was to take 150 to 200 records of this response, although in a number of instances the total fell short of this figure. The responses were recorded in groups of 25, a rest period being allowed between sets. In each case the subjects were allowed 25 practice trials. It should also be added that in the treatment of all data involving reaction times, the 5 longest and the 5 shortest readings were eliminated, as they were probably influenced by an experimental set or by distractions of one kind or another. The readings were recorded on a frequency distribution chart. The mean reaction time was found to be 324 millisecs. with a standard deviation of 39.

7. *Choice Reaction Time.*—The instructions were the same for the choice reaction response as for the simple reaction series except that the subjects were directed to respond to a light stimulus in a series pattern, viz., light 4 when it was preceded by lights 3 and 1 in the order named.

False series were introduced at random so that the subject could respond correctly only when he attended to the stimulus pattern. Each subject was given 25 or 30 practice trials in order to learn the stimulus pattern. For the most part, 350 readings were made for each subject. They were recorded in groups of 25 with a short rest period between series. For both simple and choice reactions, the subject was allowed to get off the table and walk about at the end of each 100 trials.

The data show that the mean choice reaction time is 399 millisecs. with a standard deviation of 48.

The entire experiment required approximately three hours. Where possible all the data were collected in a single afternoon. However, in some cases the photographic records were made during one period and the reactions taken at another.

DISCUSSION

Muscle-Thickening Latency as Compared with Gross Movement.—When the motor point of the rectus femoris muscle was stimulated, the mean latent time for muscle thickening was 19.4 millisecs. with a standard deviation of 4.0. The mean latent time for the movement of the leg when the same motor point was stimulated was 25.6 millisecs. with a standard deviation of 4.0. Evidently 6.2 millisecs. were lost in getting the anatomical mechanisms into action.

A Comparison of Patellar Tendon Reflex Time by Muscle-Thickening with Gross Movement Reflex Time.—Using muscle-thickening as the index, reflex time was found to be 38.8 millisecs. with a standard deviation of 5.4. The mean gross-movement reflex time was 47.0 millisecs. with a standard deviation of 4.9. The muscle-thickening reflex time was 8.2 millisecs. shorter, and less variable than the gross reflex time.

Reflex Arc Additive Properties.—Data obtained on the additive properties of the reflex arc suggest some physiologic points of interest, and also serve as a check on the accuracy and reliability of the methods employed in the experiment.

In this part of the experiment the reflex arc was broken into two resisting parts; the receptor, synapses, nerve trunks, and myoneural junction representing one, and the effector the other. It is logical to assume that by adding the latent time of the former resisting mechanisms to the latent time of the muscle, one should have a sum representing reflex time. In order to test this assumption, a comparison was made between the patellar reflex latency (muscle-thickening technique) and the sum of muscle-thickening latency and action current latency. The data show that when the mean muscle-thickening latency (19.4 millisecs.) is added to the mean action current latency (18.8 millisecs.) a figure is obtained (38.2 millisecs.) which closely approximates the mean reflex muscle-thickening time (38.8 millisecs.).

A similar comparison, substituting the gross movement measures for the muscle-thickening measure, agrees almost as well ($18.8 + 27.1 = 45.9$ millisecs. as compared to 46.8 millisecs.). However, the presence of variables, such as leg leverage, not present in muscle-thickening latency, indicates that muscle-thickening measures are more reliable.

The data seem to show that the reflex arc can be broken into at least two parts, represented by the muscle and by the receptor plus the conducting system of neurons. Since Travis and Young[11] were able to show a correlation of $.730 \pm .029$ between height and conduction time in the patellar reflex, and since muscle latency is evidently a function of structure, then reflex latency is evidently dependent upon at least the factors of height, resistance of the synapse, and muscle structure.

An Analysis of Movement on the Basis of Latent Time.—As previously stated, the main object of this experiment is to furnish a neurophysiological basis for the classification of movement. On examination of the neural structures involved in the movements above, one finds the following: first, the muscle-thickening response on stimulation of a motor point does not involve the nervous system; second, the patellar reflex involves two or three neurons; third, the simple reaction response brings into play a minimum of eight neurons; and fourth, the choice reaction act adds additional neurons to the simple reaction pattern.*

An analysis of the mean latencies and standard deviations for the subjects used in this investigation gives the results shown in Table I.

TABLE I

	Mean m.s.	Range of dist.	Average of s.d.	S.D. of dist.
Latent time	19.4	18	1.6	4.0
Reflex time	38.8	23	1.8	5.4
Simple reaction time	324.0	167	36.0	39.0
Choice reaction time	399.0	200	55.0	48.0

When the data above are considered in the light of the neural structures involved in the different movements, it becomes apparent that as we go from a reflex pattern of two or three neurons to one of eight or more neurons, there is a corresponding increase in latent time and in variability. The sharp increase in latency is easily explained on the basis of synaptic resistance, while the increase in variability is evidently due to the fact that in a movement pattern which involves more of the cortex, there are greater receptive possibilities for inhibitions (distractions).

*This concept of the neural pattern involved in the movements described was confirmed by Dr. A. R. Buchanan, Department of Anatomy, College of Medicine, State University of Iowa. The experiment of Lapp further confirms this point of view.

These results support a classification of movements on the basis of neural pattern, and justify a comparison of movements on the basis of variability, and time lost in their execution.

A comparison of the data for the simple reaction and the choice reaction shows that the difference in variability is out of proportion to the difference in latent time. Since only one or two additional neurons are brought into the pattern one would expect a small increase in latency but not so large an increase in variability. After the response stimulus is given, the neural patterns are evidently the same, but before the response, the situation is quite different. In the simple pattern, one responds only to a main stimulus, while in the choice pattern inhibitions are set up. It is evident from the data that these inhibitions influence variability, and the added neurons increase the resistance to the passage of the impulse.

The Reliability of Reading the Records.—A test of the reliability of reading records was made by taking one hundred random samples of records and having them read independently by two persons. The means of the independent readings checked to within one-tenth millisecond and the greatest individual variation was two milliseconds. Assuming a difference of two milliseconds in the same direction in every reading, the final result would be a mean two milliseconds greater or smaller and would not materially affect the reliability of the results. In fact, because of the use of means, these errors in reading would tend to cancel each other, leaving a mean result which is substantially correct.

Number of Records Required for a Reliable Mean.—By correlating odd against even scores ten readings were found to be sufficient to give a reliable mean for muscle-thickening and reflex latencies. Additional scores did not change the correlation significantly.

Nystrom, by testing the stability of the standard deviation of various numbers of readings, concluded that five or six were sufficient to give a stable mean for both the action current and reflex muscle-thickening records taken by striking the patellar tendon.[5]

A correlation of odd against even readings showed that 150 simple reactions and 200 choice reactions were ample to give reliable means.

SUMMARY

The data presented in this investigation are summarized as follows:

1. The latent period of the intact human rectus femoris muscle after electrical stimulation of its motor point was found to be 19.4 millisecs., with a standard deviation of 4.0, when measured by the muscle-thickening technique. It was 27.1 millisecs., with a standard deviation of 3.9, when measured by the gross movement technique.

2. The action current latency of the patellar tendon reflex was 18.8 millisecs. with a standard deviation of 4.4.

3. The patellar reflex latency, measured by the muscle-thickening technique, was 38.8 millisecs., with a standard deviation of 5.2 when measured by the gross movement method.

4. Simple reaction to a single light stimulus, when responding by thickening the rectus femoris muscle, was 324 millisecs. with a standard deviation of 39.

5. Choice reaction time, where the thickening of the rectus femoris was used as the index of response, was 399 millisecs., with a standard deviation of 48.

6. Reflex latency based on action currents plus muscle-thickening latency equals reflex latency based on muscle thickening, which is evidence that the techniques employed were accurate and reliable. The same is true for gross movement latency plus action current latency, since their sum approximates reflex time based on gross movement latency.

CONCLUSIONS

The data presented in this investigation show that movements can be compared neurologically by studying their latent time and the variability of this time, since the number of neurons involved varies directly with the latent time and the variability of the movement.

Neurologically, it is evident that movements differ only as the number of neurons involved differs. On the basis of the data presented, movement depends on the neural pattern, which in turn depends on the stimulus pattern. From this standpoint, all movements are, in general, alike, the only difference being in the number of neurons involved.

On the basis of the data presented it is suggested that instead of calling some movements reflex and some voluntary they be classified according to the complexity of the neuron pattern.

This experiment was carried out under the direction of W. W. Tuttle, Associate Professor of Physiology, State University of Iowa.

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Revision of the Backboard Test of Tennis Ability

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THE Backboard Test of Tennis Ability was first reported in the SUPPLEMENT TO THE RESEARCH QUARTERLY for March 1935. Since that time further experimentation has shown the desirability of certain changes.

A restraining line was found to be necessary and has been added. The original method of supplying extra balls to the player permitted too great a degree of variability. It has now been standardized. The scoring has been simplified in accordance with a suggestion made by Dr. C. H. McCloy.

It is the purpose of this article to report these changes in detail, together with certain data showing their validity. A revised set of directions for the administration of the test is also included.

RESTRAINING LINE

During the initial stages of experimentation with the test a restraining line was considered, but discarded as unnecessary. Subsequent experiments, however, showed that a player could, and sometimes would, stand very close to the wall. This was legitimate within the original organization of the test. Such a position, however, destroyed the fundamental and necessary similarity between the test and game situations, since an actual stroking of the ball was not demanded. Furthermore, disproportionately higher scores were possible.

This fault was discovered during the administration of the test to a group consisting of both men and women. Up to this time no one had attempted to assume a playing position close to the wall.[1] Certain of the men members of these groups, however, after carefully ascertaining that the directions for the test permitted *any* position, stood as close to the wall as possible. Standing within a few inches of the wall, they held the racquet directly in front of them using both hands. The ball was volleyed in a manner never used in the game of tennis and at a high rate of frequency. The players were delighted with the resulting high scores. As soon as a few individuals had tried the test in this manner others followed suit. They were allowed full freedom to do so. Their scores, when examined in relation with the scores of other groups which had remained

[1] To the certain knowledge of the author all of the data included in the original report are based on scores made while the players were further from the wall than five feet. The worth of these data is not, therefore, invalidated by this later development.

a minimum of 5 feet away from the wall, and in relation to their actual tennis ability, showed definitely that such a practice destroyed much of the validity of the test.

This experience effectively demonstrated the need for forcing players, by the use of a restraining line, to stand far enough away from the wall so that an actual stroking of the ball would be employed. Five feet was selected as being an adequate minimum distance.

The player is instructed to make all shots from behind the restraining line. This does not, of course, prohibit a player from crossing the line to retrieve a ball. In case a shot is made from in front of the line, and hits the wall on or above the net line it does not score. The person, who according to the original scoring system, was counting the number of extra balls used, now watches the restraining line. At the end of the trial the number of infringements is reported to the scorer who deducts them from the number of hits made.

It has been found that not many such deductions will have to be made. The mere fact of having a restraining line serves to prevent the deliberate assuming of a position close to the wall. Most of the infringements will be accidental. If, however, the player stands consistently nearer the wall than the restraining line, it is suggested that the trial be stopped. This point should then be re-explained and the trial begun again. Careful giving of preliminary directions will probably prevent such misunderstanding.

EXTRA BALLS

The player taking the test starts with two balls in her hand. According to the original organization extra balls were supplied as they were needed by another person. This person collected balls and stood ready to hand them to the player. This method proved itself too variable. There was some confusion with the player running to get a new ball and the helper getting in the way in order actually to *hand* her the ball. Some persons, thinking to be more helpful, would *toss* the ball to the player, and some would *bounce* it to her. Occasionally the thrown ball would be missed by the player, resulting in an illegitimate loss of time. Such variations obviously would reduce the objectivity and reliability of the test since the testing situation was seldom, if ever, quite the same for all players.

To circumvent this difficulty the following change has been made. All extra balls, both at the start and as they are collected during the test, are placed in a box, which should be about 12 by 9 inches and 3 to 4 inches deep. The box in which a dozen balls are purchased is recommended.

This box is put on the floor at the left (for right handed players and at the right for left handed players) of the playing area, where the re-

straining line joins the side. In this position it will be convenient to the player, but not in her way. It will present the same situation to all players, as far as the obtaining of extra balls is concerned.

NEW METHOD OF SCORING

Some time ago Dr. McCloy wrote the author inquiring if the subtraction of extra balls from the hits scored might not be unnecessary. He suggested that the time consumed in putting another ball in play might cause a sufficient reduction in score without any additional penalty. If this were true it would be necessary to count only the number of balls hitting on or above the net line and the method of scoring would be much simplified.

TABLE I

CORRELATION COEFFICIENTS

NEW METHOD WITH OLD METHOD OF SCORING

Group	r	No. of Cases	Range, New Method	Mean Score New Method
Texas Data				
Group A—Majors	.98	15	21 — 60	35
Group B	.95	14	22 — 41	32
Group C	.96	37	19 — 60	33
Re-test				
Group A	.98	15	22 — 62	39
Group B	.99	14	26 — 50	35
Group C	.98	37	22 — 62	37
Purdue Data				
First Test	.94	60	7 — 48	28
6 weeks instruction				
Final Test	.96	57	18 — 50	34
Arnold Data—Majors				
Women	.97	35	12 — 90	42
Men	.98	24	40 — 92	64
Men and Women	.97	59	12 — 90	
Women Combinations				
Arnold and Texas	.94	74	12 — 90	38
Arnold, Texas, and Purdue	.97	135	7 — 90	34
Men and Women Combinations				
Arnold and Texas	.98	98	12 — 92	
Arnold, Texas, and Purdue	.95	159	7 — 92	

TABLE II

COMPARISON OF RELIABILITY COEFFICIENTS USING NEW AND OLD METHODS

Group	New	Old	No. of Cases
Texas Data			
Group A	.92	.90	15
Group B	.87	.87	14
Group C	.86	.80	37

With this in mind the original sets of data were reviewed. Additional data were also obtained, including a group of scores made by men. Cor-

relations were run between the new method and the old method. The new method computes the scores on the basis of hits made. The old method subtracted the number of extra balls used from the hits made. Table I shows that the new method correlates highly with the old method, and it may therefore be accepted as a valid means of computing the score. Table II shows that the reliability coefficients between two applications of the test are as high or higher when the new method of scoring is used. This again proves that the new method is statistically, as well as practically, acceptable.

The validity of the Test was first established by the use of the Round Robin criterion with one set of Texas data. It is interesting to note that the coefficient obtained by correlation this criterion of playing ability with the test is .90 when the old method is used, and .92 when the new method is used.

The correlation between the first test and the final test on the Purdue data is not included in the Table of Reliability Coefficients, although it might apparently belong there, because of the six weeks period of instruction which intervened. Normally the correlation between the first and second applications of a test would show the reliability of the test. In this case, however, the relationship between the first test and the final test, due to the long interval between them, has no meaning as far as reliability is concerned. It is significant, however, in relation to the validity of the test. If a test actually measures what it is supposed to measure, in this case, tennis ability, then the coefficient between two applications, separated by instruction and practice, should be low. This being true it follows that the coefficients of .67 and .70 (Purdue Data 54 cases) using the old and new methods respectively, indicate again that the test is a valid instrument. This argument is based on the reasonable assumption that the six weeks period of instruction and practice resulted in increased skill. That this increase was not proportionally equivalent may be taken for granted. This statement is based on the fact that increase in skill at the high levels of ability is more difficult and proceeds more slowly than at the low levels. Furthermore, it is known that persons with high capacity to learn skills do so at a more rapid rate than do those with little such capacity. The Purdue groups were heterogeneous both as to ability and as to capacity.

Table III gives the T-Scale values for the new method scoring. The Scale was constructed with the data here reported on the basis of three standard deviations above and below the mean. It is comparable to the T-Scale provided for the old method scoring by Cozens, Cubberley, and Neilson.[2]

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[2] Cozens, Cubberley, and Neilson, *Achievement Scales in Physical Education Activities for Secondary School Girls and College Women.* (New York: A. S. Barnes and Co., 1937), p. 106.

REVISED DIRECTIONS

Equipment.—1. Backboard or wall, approximately ten feet in height and allowing about fifteen feet in width per person taking the test at one time. Two players taking the test at once has been found to be a very satisfactory arrangement. This allows for adequate supervision by the administrator.

TABLE III

T SCALE FOR NEW METHOD SCORING

T Scale	Test Score	T Scale	Test Score	T Scale	Test Score	T Scale	Test Score
100	67	75	50	50	33	25	16
99	66	74	49	49	32	24	15
98		73		48		23	
97	65	72	48	47	31	22	14
96	64	71	47	46	30	21	13
95		70		45		20	
94	63	69	46	44	29	19	12
93	62	68	45	43	28	18	11
92		67	44	42	27	17	10
91	61	66		41		16	
90	60	65	43	40	26	15	9
89	59	64	42	39	25	14	8
88		63		38		13	
87	58	62	41	37	24	12	7
86	57	61	40	36	23	11	6
85		60		35		10	
84	56	59	39	34	22	9	5
83	55	58	38	33	21	8	4
82		57		32		7	
81	54	56	37	31	20	6	3
80	53	55	36	30	19	5	2
79		54		29		4	
78	52	53	35	28	18	3	1
77	51	52	24	27	17	2	
76		51		26		1	

2. On this wall a plainly visible line three inches in width, to represent the net, should be drawn so that the top is three feet from the ground.

3. A restraining line, five feet from the base of the wall, should be drawn on the floor.

4. Stop watch with second hand.

5. Two balls and a racquet per player. It is desirable that the balls be in good condition, although it is not essential that they be exactly new. The racquet should be without flaws.

6. Box for extra balls, about 12 inches long, 9 inches wide and 3 inches deep, placed on the floor where the restraining line joins the side at the left for right handed players and right for left handed players.

7. One pencil per group of four players.

8. Score card per player.

Organization.—Divide the group to be tested into units of four players each, and number them from one to four. Provide each player with a score card on which she writes her name. Then read the following description of the test to the group.

"The Backboard Test consists in rallying a tennis ball against the wall. The object of the test is to cause the ball to strike the wall on or above the net line as many times as you can in 30 seconds. (Pause) When I say 'Go!' start the test immediately. Drop the ball and let it hit the floor once, then put it in play against the wall. Continue to play it to the wall until I say, "Stop!' at the end of 30 seconds. There is no limit to the number of times the ball may bounce before you hit it. You may volley the ball. The ball need not touch the floor before you play it except at the start and when a new ball is being put in play. You may use any stroke or combination of strokes. You must play all balls from behind this restraining line (indicate the line clearly). You may cross the line to retrieve balls, but any hits made while in such a position do not count. You may use any number of balls. If for any reason you lose control of the ball in play, do not try to retrieve it. Take another ball from this box (indicate clearly) and put it in play as you did at the start. Each ball striking the wall on or above the net line before the word 'Stop' counts as a hit and scores one point. You will each be given three trials today. The final score on the test is the sum of the scores on the three trials."

Demonstrate the following points:

1. Two balls in hand.

2. Start test by dropping ball, letting it hit floor at least once, then play it.

3. Rally a few times, showing volley.

4. Cross restraining line to retrieve a ball, a low hit to keep it in play and retreat for next shot.

5. Make a wild shot to show how taking another ball saves time. Put this new ball in play as at the start.

Read the following paragraph, making certain that each person understands the test procedure and her duties.

"In each group:

"No. 1 takes the test. At the signal, 'Ready?' she stands anywhere behind the restraining line with her racquet and *two balls* prepared to start the test at the word 'Go!'

"No. 2 counts the number of balls which strike the wall on or above the net line *before* the word 'Stop!' and enters them on the score card

opposite the appropriate trial number. If any infringements are reported by No. 3 these are deducted before the score for the trial is recorded. A ball striking coincident with the word 'Stop!' does not count.

"No. 3 watches the player in relation to the restraining line. She reports to the scorer at the end of the trial the number of hits, if any, made while the player was standing closer to the wall than the restraining line.

"No. 4 collects the balls of her group before the start of a trial and puts them in the box. During the trial she collects and returns to the box any balls going out of play.

"Each person takes the test in rotation. After No. 1 has had her first trials she assumes the duties of No. 2 while the latter takes the test; No. 3 and No. 4 remain the same. While No. 3 takes the test, No. 4 scores the hits, No. 1 and No. 2 assume the duties of No. 3 and No. 4 respectively. When No. 4 takes the test, No. 3 scores hits, and No. 1 and No. 2 remain the same. After each person in the entire group being tested has had one trial, the test is repeated in the same order until everyone has had three trials in all."

Answer questions. This organization will consume about ten minutes. Great care should be exercised in these preliminaries to make certain that the test procedure is clearly understood. The testing will then take place smoothly and accurately.

The examiner then assumes a position to the rear of the players with the stop watch, and begins testing the No. 1's who are to take the test at one time, usually one or two. Numbers 2, 3, and 4 of these groups will follow, and then the No. 1 of the next two groups, and so on until all have had one trial, after which the test is repeated twice in the same order. In case the group does not divide exactly into groups of four, adjust groups to suit.

The Validity of the Pulse-Ratio Test of Cardiac Efficiency

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THE usefulness of measurements of functional or physiological efficiency is seriously limited by inadequate validation. In the field of cardiovascular tests, many measurements of validity have been based on criteria related to medical diagnosis. Other criteria used have been largely indirect. A recent exception is Flanagan's very interesting report[2]* that the pulse ratio test developed by Tuttle[8] has predictive value in estimating the relative endurance of sprint runners. The test apparently failed to predict the endurance of untrained runners and certain individuals who showed peculiarities of stride, the limitation with one exception being due in Flanagan's opinion to inapplicability of the criterion to these selected cases rather than failure of the pulse-ratio test itself. Sixteen per cent of the data were discarded on this basis, the correlation rising from —.50 before selection to —.89 after selection. The correlations are large enough to promise practical utility of the test, and warrant more intensive investigation. A further analysis of the relationships forms the subject matter of the present study.†

APPARATUS AND METHODS

The test as devised by Tuttle requires only a stool and stopwatch.[8] However, in the interests of objectivity and in order to provide data that could be completely analyzed with respect to temporal factors, graphic recording of pulse was employed in the present study.

The test is based on the ratio of the total two minute post-exercise pulse to the one minute pre-exercise count. The standard exercise consists of mounting and demounting a 13-inch stool at a predetermined rate for one minute. The pulse ratio for exercise at the rate of 18 mounts per minute is first determined; the subject rests for 12 minutes, and finally the ratio for 40 mounts per minute is secured. The number of mounts that would have yielded a pulse ratio of 2.5, calculated by linear interpolation, is the subject's score. Flanagan exercised some of

* Indices refer to numbered Bibliography at end of article.

† The research laboratory of this department is undertaking a study of cardiovascular tests, and the relation between cardiac phenomena and exercise. One phase of the study involves the development of improved apparatus and methods for use in this field. A brief description of one of the instruments, which electrically counts the heart beat, has recently been published[4] and a description of a direct reading pulse rate meter is in press.

his subjects at 45 mounts per minute, a speed which we found in preliminary experiments to be undesirable because of excess activity due to slipping and similar difficulty, and also because many subjects could not uniformly maintain this high rate. In case the subject actually exercised more rapidly or slowly than the standard rate, the actual number of mounts was used in the calculations. A standard inter-exercise rest of 12 minutes was adopted in preference to the common practice of resting until the pulse rate returned to normal, because, insofar as the writers are aware, it has never been established that such pulse rate return is a valid measure of return to physiological normality (which is obviously dependent upon several factors). That the rest interval used was sufficient for the heart rate to return to the pre-exercise value is shown by the fact that the average resting rate before the second exercise was 0.35 of one beat slower than the average rate before the first exercise. This difference is too small to be of significance; the direction of the change being negative is additional proof.

The apparatus consisted of an electrically driven polygraph and the necessary attachments.[1] A light weight celluloid pen driven by an all metal pneumo-mechanical system similar to that used in anaeroid barographs furnished an inked record on a paper tape. This system was connected to an inflated sphygmomanometer bag placed on the arm of the subject. Electrical contacts on the stool activated a pen which recorded the number of mountings, and related them chronologically with the pulse record. A third pen recorded time in seconds.

All subjects received a minimum of 20 minutes rest before the test. If questioning revealed that a particular subject had physically exerted himself more than a minimal amount, additional rest was given in proportion to the severity of the exertion. In no case had extensive pre-test physical activity been engaged in. Resting pulse was calculated by averaging the rate for the two minutes immediately preceding the standard exercise. The post-exercise two-minute count was uniformly begun five seconds following the instant of the end of the last mounting. Since sitting pulse was employed (as in Flanagan's experiment), several seconds were required for making the change of posture, the exact time being variable. The interval chosen was sufficient to allow for this variability. Tuttle stresses the importance of beginning the count immediately after exercise because of the rapid drop in rate. In the writers' opinion, it is a necessary corollary that the interval must be constant. An analysis of the quantitative importance of this interval is to be included in a later communication.

In addition to Tuttle's scoring system, a second method was used, since preliminary analysis of the data revealed a negative correlation of .34 between weight and raw scores. It is obvious that the work done per unit time is a direct function of the weight of the subject. It can be equalized by simply dividing the number of mountings by the weight

of the individual, since Tuttle and Wells[9] have shown the pulse ratio to be a linear function of the number of mountings per minute (i.e. the amount of work per unit time). In order to facilitate comparison with the data of other workers, the quotient was multiplied by the average weight of the subjects. Scores calculated by this procedure will be designated "weight-equated."

All criterion scores are given in terms of time rather than speed. A positive relation between test scores and endurance will therefore be indicated by a negative coefficient of correlation, and a negative relation between speed and test scores will result in a positive coefficient.

CRITERIA

Endurance, in so far as conclusions to be drawn from the present report are concerned, is empirically defined by the criteria used (namely the "endurance index" or some similar measure). Nevertheless, a somewhat broader definition is probably warranted. The ability of an organism to continuously maintain a certain work output may be considered endurance; the ability to maintain a relatively high work output without decrement may be considered endurance also. The ability to maintain a high level of work without damage to the organism may also be thought of as endurance, but this type falls outside the field of the present investigation.

The degree to which a subject maintains in a 220-yard run the speed he establishes in a 60-yard dash was used by Flanagan as a measure of endurance in sprint running, the ratio of the time for the 220-yard run to that of the short run being called an "index of endurance." This and other methods of estimating endurance were used as criteria in the experiment being reported. The procedure for timing the short run was modified somewhat, the subject running 70 yards instead of 60, and being timed at 10 yards from the starting line as well as the finish.* Following a suitable rest period, the 220-yard run was made. The two sprints were run separately in order to avoid the effect of a possible tendency of the runner to conserve his energy in the first part of the longer run. The runs were made on a straight cinder track in the late afternoon of the same day that the pulse-ratio test was administered, the time between the test and the run varying from less than one hour to a maximum of seven. All criterion scores were obtained under non-competitive conditions.

A second criterion was based on a step-climbing speed. The bleachers adjacent to the track provided a continuous straight climb of 36 steps in addition to space for starting and stopping. It was hoped that

* Flanagan (*loc. cit.*) used the average of two 60-yard runs in order to secure high reliability. Anticipating the experimental results, in the present case a correlation of .94 was found between 60- and 220-yard time; the reliability was necessarily at least this large. The use of two runs would not have raised this already high figure to more than .97, and could have had no more than a negligible effect on the final correlations.

scores on this criterion would be somewhat less subject to the influence of special skills or training than in the case of running, although it was realized that such influences would not be eliminated completely. Time scores were taken at steps 10 and 36, corresponding to a vertical rise of 9 feet, and an additional rise of 27 feet. In about half the cases the step-climbing was done one day after the other tests had been given, while for the other subjects a delay ranging to as much as a week intervened. Inasmuch as the work actually done was a function of the subject's weight, the raw time scores were divided by the weight and multiplied by the weight of the average subject, under the assumption that speed was linearly related to the work done. While this relationship was not actually determined, it may probably be assumed without serious error that the function was approximately linear within the limits of the data.

EXPERIMENTAL RESULTS USING THE SPRINT CRITERION

Data were secured on 28 male subjects.* Approximately one-third of the group may be considered more or less naïve in so far as running on the track is concerned, and were in no sense "in training." Another third had varying small amounts of experience, either in high school or in physical education classes. None of these individuals were in training.

TABLE I

CHARACTERISTICS OF THE EXPERIMENTAL GROUP

	Mean	Standard Deviation
Weight (lbs.)	172.	16.0
Age (yrs.)	22.3	3.3
Steps for 2.5 P.R. (raw)	30.	6.6
Steps (weight equated)	29.	9.7
Endurance index (220/60)	4.08	0.16
Time in sec. 220 yards	26.9	2.65
Time in sec. first 10 yards	1.98	0.14
Time in sec. net 60 yards	6.58	0.45
Time in sec. Step climbing, first 9 ft.	2.67	0.24
Time in sec. Step climbing, last 27 ft.	6.08	0.38

(Step-climbing scores are not weight-equated)

Five individuals were in training; one was a two-mile runner, one a half-miler, and the other three specialized in the sprints. The rest of the subjects can be considered as intermediately between the second and last groups. The range of talent can best be expressed by giving the range of time scores for the 220-yard run, namely 22.0 to 34.9 seconds. The composition of the experimental group with respect to other significant fac-

* The writers wish to express their appreciation to Coach Brutus Hamilton of the Associated Students of the University for his cooperation, to the various students who served as subjects or assisted in the timing, and to Mr. H. J. Graham for valuable suggestions and for reading the manuscript.

tors is given in Table I on the preceding page.

The first relationship studied was that between the raw pulse-ratio score and the index of endurance (i.e. the 220/70 sprint score). A correlation of —.28 was found. Since variability in starting time could have caused some attenuation, the time for the first 10 yards was subtracted from the 70-yard time, raising the correlation to —.29. These coefficients are discouragingly low. However, when the pulse-ratio score is based upon the actual work done in the test exercise (i.e. by using the weight-equated scores), the correlations rise to —.48 for the case of the 220/70 index, and — .50 for the 220/60 index.

Let us now examine the theoretical justification for using the ratio index as a measure of endurance. This index may for purposes of argument be represented by the equations

$$E = \frac{(CY)\ X}{X} \qquad \text{or,} \qquad E = \frac{X + (C'Y')\ X}{X}$$

where X is the speed factor as measured by the time on the short dash, C is a constant of proportionality relating the distances on the long and short dashes, C' a similar constant relating the short dash to the last 150 yards of the 220, and Y and Y' are factors controlled by lack of endurance. The denominators therefore represent the time on the short dash and the numerators the 220-yard time, the factors in the brackets in the second equation representing the time of the last 150 yards. It is obvious that the speed factor X cancels out in both these ratios, and that this cancellation will occur if and *only* if X is a single linear factor in all terms of the numerator. (It is realized that the functional relation between C and Y is more complicated than represented above, but this does not invalidate the argument.)

If Y and X (i.e. endurance and speed) should turn out to be correlated, it can be shown that X is not a simple linear factor in the 220-yard time, and that the index will still contain the speed factor. Experimentally it is found that the 60-yard time correlates .50 with the endurance index and .54 with a new index based on the estimated time for the last 150 yards divided by the 60-yard time. This failure to eliminate the speed factor might not be so very important if it should turn out that speed as such has no correlation with pulse-ratio scores, but it is found that the net 60-yard scores correlate —.21 with the raw pulse-ratio scores, and —.19 when they are weight-equated. This situation will receive further discussion later.

Fortunately there are other ways of looking into the relation between test and criterion. It is possible through the use of the technique of partial correlation to hold the influence of speed constant by statistical means.[5] Applying this method to the 220- and 60-yard data, it is found that the correlation with the weight-corrected pulse-ratio scores is —.46 when the influence of speed as measured by the 60-yard time is held

constant. Using the estimated time for the last 150 yards obtained by taking the difference between the 220- and 70-yard times, and again holding the speed factor constant, it is found that the coefficient is —.44. This slight reduction in degree of relationship is probably not significant.*

When the time on the 220-yard run is held statistically constant, the partial correlation between the pulse-ratio scores and 60-yard data is positive, and has a value of .38. The corresponding correlation when the 220 minus 70-yard time is held constant, is .34. That this positive correlation exists is not surprising, when it is remembered that we have held constant not endurance, but time on the longer run. We have defined endurance as the ability to maintain speed without decrement, hence high endurance will be indicated by (a) a comparatively low time score on the long run, or (b) a comparatively high time score on the short run. Holding statistically constant the time score on the short run, we find high pulse-ratio scores associated with low time scores on the long run just as in case (a) above, and holding constant time on the long run the high pulse-ratio scores are associated with high scores as in (b). The inference is precisely the same in both these cases, namely that high pulse-ratio scores mean high endurance.

The scores on the 10-yard part of the run are found to show about the same interrelations with the 220-yard and pulse-ratio data as the 60-yard scores exhibited. Holding speed constant the correlation is —.39, and holding the 220-yard time constant a positive coefficient of .23 is found. When partial coefficients are calculated using the 60- and 10-yard data, the pulse-ratio scores correlate —.19 with the 60-yard time holding 10-yard speed constant, and only .08 with speed holding 60-yard time constant. The 10-yard time, by itself, correlates —.07 with pulse-ratio scores. Since the probable error of these last four coefficients is about .12 it is inferred that the 60-yard time is not very much influenced by the endurance factor and may even be entirely independent of it. The absence of correlation here is not due to variability of starting time since the 10-yard time correlates .68 with 220-yard time, .65 with 220 minus 70 time, and .68 with the 60-yard time that was obtained by subtracting the 10-yard scores from the 70-yard run.

In the light of the above results, it seems likely that the observed intercorrelation of .91 between the 60-yard time and the last 150 yards of the long run (see Table II) is conditioned by both speed and endurance common to the two; the coefficient of .65 found between 10 and 220 minus 70-yard time is probably a lower limit of the speed commonality, which cannot be precisely determined with the available data.

* It should be pointed out that the probable errors of the coefficients cannot be used to evaluate the significance of differences in intra-group correlations because such errors are measures of sampling error. The immediate problem is not concerned with whether separate experimental groups would show these same values of intra-relationships, but rather is concerned with the significance of the relations within this particular set of data.

Weight is found to be positively correlated with the weight-equated pulse-ratio scores to the extent of .53. This gives rise to the suspicion that a change in relationship may have been caused by the procedure used in equating the pulse-ratio exercise for weight. Weight does not seem to have a very extensive direct relation with the time on the sprints, the zero order correlations being .013 with the 220 time and .089 with the 60-yard scores. There is a possibility, however, that it is correlated with endurance. It is found to correlate —.19 with the ratio index of endurance, and yields a partial coefficient of —.20 with 220-yard time when 60-yard speed is held constant. It is impossible to get around this trouble by using the "raw" pulse-ratio scores before correcting them for weight, because as will be recalled from the discussion of methods, the "raw" scores show an appreciable negative correlation with weight, namely —.34. In fact this was one of the factors that led to the using of the weight correction. Partial correlation may again be used in analyzing the situation. Holding weight constant, it is found that the coefficient relating the "raw" pulse-ratio scores and the 220/70 index rises from —.29 to —.39, and the coefficient based on the weight-equalized pulse-ratio scores drops from —.50 to —.41. The close agreement between these two values indicates the effectiveness of the statistical technique.

Now it becomes necessary to hold constant the influence of both speed and weight. This can be done by extending the calculations to secure a second order partial coefficient. Such a coefficient based on the 220-yard data has a value of —.42, which is somewhat lower than was the case when speed alone was held constant. The corresponding coefficient using the 220 minus 70-yard data (i.e. the last 150 of the 220-yard run) is —.39, again a slight decrease. Apparently the equating of the weight factor in the raw scores has produced a concomitant contribution to the degree of relationship. This probably occurs through the effect of two tendencies. Holding constant the speed factor weight is correlated negatively with the 220 time to the extent of —.20, and when the 220 time is held constant a positive partial correlation of .22 is found. This is to some extent what one would expect, for with other things equal a heavy person is handicapped with respect to speed. It also seems reasonable to find heavier subjects showing greater endurance, when the possibility of interrelations with age and nutrition in a group such as the present one is considered. It is interesting to note that the partial correlation with the 220 minus 70 data is slightly higher, namely —.24 with speed constant and —.28 with the time on the longer run constant.

EXPERIMENTAL RESULTS USING THE STEP-CLIMBING CRITERION

The 36 step climb required only an average time of 8.8 seconds, indicating that the task was probably too easy to be much of a test of

endurance. This is confirmed by the subjective reports of the runners, who did not consider it a severe test of their capabilities. Also, the scores are probably not as reliable as those based on the runs. This is suggested by the intercorrelation between the two parts of the climb, which is only .75 as compared with .91 for the runs, and drops to .38 when the common factor of weight is partialed out. In the case of the runs, removing the effect of weight does not noticeably alter the intercorrelation. Of course .38 is a limiting value, and the true reliability will be higher to an extent determined by the amount that the endurance factor is differentially affecting the last part of the climb, but even after making due allowance for this the reliability still appears to be quite low.

For this reason, an extensive analysis of the data does not seem to be warranted. A correlation of only —.17 is found between the last part of the climb and the pulse-ratio scores, when speed as measured by the time on the first part of the climb is held statistically constant. An index of endurance similar to that used in the previous experiment yields a positive correlation of .25 with the pulse-ratio test, however this upset is probably not significant in the light of the probable low reliability of the first part of the climb.

Apparently the first part of the climb is not an adequate determiner of speed. The time on the 60-yard run can be substituted for it with interesting results, raising the partial correlation between the pulse-ratio test and step-climb to —.51 if only the last part of the climb is used, and —.56 if the time for the complete climb is employed.

COMBINED CRITERIA

It is desirable now to study the relationship between both criteria and the test. The extent of overlapping between the criterion scores is apparently low, since the complete step climb correlates only .36 with the 220 time, and the last part yields a coefficient of .26 with the last 150 yards of the run. This leads to the expectation that we should find a higher correlation between the combined criteria and the test than between the test and either criterion taken alone. In order to determine this sort of combined relationship, it is customary to employ the coefficient of multiple correlation. In the present case, this is not adequate since we must eliminate the effect of speed, and probably weight also. Fortunately, Stouffer has described a method for obtaining a coefficient of partial multiple correlation that is suited to the problem.[6] Such a coefficient giving the multiple relation between the pulse-ratio scores and the step climb together with the 220-yard run, holding constant the influence of 60-yard time, has a value of .64. (The sign of a multiple coefficient is always positive, since only extent and not direction of relationship is indicated.) When the effect of weight is also held constant, the correlation drops to .44.

MUSCULAR ENDURANCE AS A FACTOR IN THE RELATIONSHIPS

In order to determine whether general muscular endurance is a factor affecting the relationships the subjects were tested in the following manner: A Smedley dynamometer was pneumatically connected to the polygraph recording mechanism. The dynamometer was operated by the favored hand in cadence with the continuously repeated command series "grip—hold—relax." Each element of the series was separated from its neighbor by one second, timed by the sound of the second-recording mechanism on the polygraph. The subjects were frequently encouraged verbally to squeeze the dynamometer maximally each time. The series was continued until the magnitude of the squeeze had dropped to about a third of its initial value.

Muscular strength as measured by the first squeeze correlates —.04 with the 220/60 endurance index. This is obviously not significantly different from zero. A low positive correlation, namely .30, is found between the first squeeze and the pulse-ratio scores.

It is possible to use an "index of muscular endurance," comparable to the 220/60 index. One way of doing this is to employ the ratio of the magnitude of the first squeeze to that of some later one. Inspection of the records indicates that the fifteenth is most suitable for this purpose. The index calculated in this way (i.e. by dividing the magnitude of the first squeeze by that of the fifteenth) ranges from 1.14 to 2.14. It will be noted that this is indicative of greater response decrement than in the case of the sprint index.

The correlation between the index of muscular endurance and the index of sprint endurance is —.19. Between muscular endurance and pulse-ratio scores, the correlation is .21. Probably neither of these coefficients are significant, since they are only slightly larger than their standard errors. The influence of initial strength may be held constant by the method of partial correlation. When this is done, the correlation between the fifteenth squeeze and the pulse-ratio test is —.10. The reliability of the dynamometer tests was not determined, but is inferred to be at least as high as the correlation between the first and fifteenth squeeze, namely .76. While this is not particularly high, it is of sufficient magnitude to show that the low magnitude of the correlations found is not merely the result of low reliability.

DISCUSSION

The results of Flanagan numerically nearest to those obtained in the present experiment are his correlations based on unselected data. His coefficient of —.52 is not significantly different from the correlation of —.50 that we found between the index of endurance and the weight-adjusted pulse-ratio scores. Our raw score correlation of —.29 obtained under conditions comparable to his, is low. The difference is perhaps

TABLE II

ZERO ORDER CORRELATIONS

(Product-moment method)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Pulse-ratio (raw)	1			—.29	—.28	—.21			—.34		.19	.21		.14	—.28	—.29			
Pulse-ratio (wt.-equated)	2			—.33	—.35		—.19	—.07	.53	—.02	—.58	—.53	—.19	—.58	—.48	—.50	.30	.17	.21
220-yd. time	3	—.29	—.33				.94	.68	.01		.36					.76			
220 minus 70-yd. time	4	—.28	—.35				.91	.65	—.02			.26				.80			
70-yd. time	5	—.21																	
60-yd. time (net)	6		—.19	.94	.91			.68	.09		.27	.23				.50			
10-yd. time	7		—.07	.68	.65		.68		—.03			.20		.25					
Weight	8	—.34	.53	.01	—.02		.09	—.03		.24	—.82	—.77	.01	—.78		—.19			
36 step time (raw)	9		—.02						.24				.72						
36 step time (wt.-equated)	10	.19	—.58	.36			.27		—.82					.89					
36 minus 10 time (wt.-equated)	11	.21	—.53		.26		.23	.20	—.77					.76		.23			
10 step time (raw)	12		—.19						.01	.72									
10 step time (wt.-equated)	13	.14	—.58					.25	—.78	.89	.76								
Endurance index (3/5)	14	—.28	—.48																
Endurance index (3/6)	15	—.29	—.50	.76	.80		.50		—.19			.23					—.04		—.19
First dyn. squeeze	16		.30													—.04		.78	
Fifteenth squeeze	17		.17														.78		
Musc. End. Index (16/17)	18		.21													—.19			

not statistically significant, as the critical ratio is only 1.7 *PE*. The majority of his subjects were "in training for track" while most of those in the present experiment were not, but this is a difference that may be more apparent than real because 48 per cent of his subjects ran the 220 in from 25 to 27 seconds compared with 54 per cent of ours. The range of his scores was noticeably narrower than ours.

It has been argued that the use of the endurance index is theoretically not justified, hence a more significant comparison would be that based on the results with the partial correlation technique. Fortunately, Flanagan's protocol is available making it possible to apply this method to his data.[8] A partial correlation of —.41 is found between pulse-ratio scores and 220 time when 60-yard time is held constant, as compared with our —.25 for raw scores and —.46 using the weight-adjusted data. If his case No. 17 is discarded, his correlation rises to —.46. None of these differences are statistically reliable, so they may be attributed to sampling error. The closer correspondence when weight-equated scores are used, which was also met with when the "endurance index" comparison was made, suggests that Flanagan's subjects may have been considerably more uniform in weight than ours were.

The coefficient —.89 reported between pulse-ratio scores and the endurance index after Flanagan's selection of data is probably significantly higher than the relationship found in the present experiment, but we are inclined to doubt the justification of the selection. One case (No. 17) Flanagan believes may have been in poor "health condition"; if this single case is left out, we find that the remainder of his *discarded* cases show a partial correlation of —.57 between test and criterion. It is realized that calculations based on so few cases have little real meaning, but the fact that the coefficient is so similar in magnitude and sign to that based on the unselected data, is too striking to be completely ignored.

Of additional significance is the observation that using these selected data of Flanagan's, a *positive* zero order correlation of .55 is found between the 60-yard time and the test. Now, since the test showed a high *negative* correlation with the endurance index, it follows that if the index is a measure of endurance, the factors responsible for endurance must of necessity not be held in common with speed, because our data also show a negative correlation between test and index, but a *negative* correlation between test and 60-yard time. Similarly, the relations between the index itself and 60-yard time are of opposite sign in the two experiments. The same conclusions follow from a consideration of the partial correlations. When the effect of speed is held constant, endurance as measured by the 220-yard time correlates —.83 with the test, and speed yields a coefficient of .89 when 220 time is held constant. These results are similar to ours even though the zero order coefficients

did not agree in sign with ours.

It seems logical to conclude on the basis of the above and other considerations, that the endurance factor is, and can only be, among the residual factors that prevent 60- and 220-yard time from correlating unity. (Obviously, if the correlation was unity, one variable would completely determine the other.) The limits for these factors can be evaluated.[7] In Flanagan's selected data, the 220- and 60-yard times correlate .84, hence the value of the undetermined factors cannot exceed $\sqrt{1-r^2}$, or .55 (subject to the usual allowance for chance). Even this value may place too high a limit on the endurance factor, because it includes the residuals originating from the failure of the runs to have a statistical reliability of unity. The observed amount of relation was considerably higher than .55, namely .89. Clearly, if this analysis is justified, the coefficient of .89 is spuriously high because of the selection of data.

Earlier in this paper, theoretical reasons were given for arguing that dividing the 220-yard time by the 60-yard time to obtain an "index of endurance" may not properly eliminate the speed factor. This can be tested statistically. It is found that the endurance index correlates —.51 with the 60-yard time in Flanagan's selected data and —.39 in his unselected data. If the speed factor had been eliminated in the endurance index, this correlation should have approximated zero.

The fact that the residual speed is higher in the endurance index of his *selected* data than in the case of his *unselected* data argues against the justification of the selection. In addition, the selected data show a *higher* correlation (—.84) between 220- and 60-yard time than do the unselected data (—.80), and a *lower* correlation between the pulse-ratio scores and the 220-yard times, namely .08 as compared with .19. Yet, for the selected data, the correlation between the pulse-ratio scores and endurance rises to —.89, although it was only —.52 before selection.

The writers are of the opinion that the limitation of measurable endurance imposed by the intercorrelation between 60- and 220-yard time is a real limitation, and indicates that Flanagan's selection of data resulted in a spuriously high relationship. This does not mean that the true validity of the pulse-ratio test as a measure of endurance is limited to the particular numerical values given by his unselected data or found in the present experiment; on the contrary it is quite possible that the use of a run considerably longer than 220 yards would permit, and result in, a higher value. However, from physiological considerations it is clear that cardiac efficiency is only one of several contributors to endurance as we have defined it, and it would be surprising to find that it determined endurance to the extent of —.89 or .90. Actually a correlation of this size can be shown to imply complete determination of endurance by cardiac phenomena, when the necessary allowances are made

for attenuation due to absence of perfect reliability in the test, and in the criterion score. Another point that must be considered is that blood pressure phenomena cannot be entirely neglected. The data do seem to warrant the conclusion that the pulse-ratio test properly used is a measure of some factor that determines endurance in sprint running to at least the extent of —.40 or .41. Endurance of a somewhat more general sort is apparently tested to the extent of —.44 (as found by the partial multiple correlation technique) and perhaps even .64, although the significance of this latter coefficient is open to question since the weight factor was not partialed out.

This degree of validity is of course low, but is certainly high enough to have some significance. It compares very favorably with the validity of some tests of accepted usefulness in other fields such as, for example, mental measurements. In its present form the test is of limited usefulness for prediction of endurance of the individual, although group means can be satisfactorily determined. The validity is certainly high enough to justify the use of the test in a test battery. The validity of the test as a measure of cardiac efficiency as such was of course not determined in the present experiment; this is largely of theoretical rather than practical interest in the field of applied physiology, where the problem is to determine validity in terms of predicting the performance of the organism in typical life-situations. Nevertheless, this theoretical aspect of the validity can very likely be investigated with profit since it offers the most direct route for improving the test. This type of study is under way in our laboratory at the present time.

The observed degree of determination of endurance by the test is seemingly not limited to trained athletes in condition only, but is extended to include the range of ability evidenced in Table I, over a range of condition that varies from poor to excellent as determined by subjective estimates by the experimenter and by the subject's own estimate.

It is believed that the step-climbing criterion is worthy of further investigation. It probably would have been more effective had a consecutive series of climbs been made, or had a much longer flight of steps been available. Attenuation very likely occurred in the relationship because of the lapse of time between the administering of the pulse-ratio test and the step-climbing test. In a number of cases, it will be recalled, the delay was as long as a week. A simple electrical timing device would probably have materially improved the reliability of the data, particularly on the short runs and climbs. The use of the electric pulse-counter would have made it possible thoroughly to analyse the heart rate during as well as after the test exercise.[4]

Before discussing the results of the muscular endurance test, it should be pointed out that we are quite aware that data on the forearm muscle groups do not accurately reflect the muscular situation in the

body as a whole, and that measurement of groups of leg muscles would have yielded data bearing more directly on the problem. This was largely an exploratory experiment, making use of a set-up that was available at the time. Nevertheless, certain facts do emerge. For example, a "general" muscular endurance would have been best measured by the behavior of muscle groups not directly involved in the activity. Apparently this type of endurance is not a factor in the pulse-ratio test. Neither is it a factor in sprint endurance as measured by Flanagan's index. The existence of a correlation between initial strength and pulse-ratio scores is interesting. In a heterogeneous group of subjects such as ours, strong forearm muscles are probably indicative of a strong individual, whose heart would be relatively less taxed by the standard exercise of the pulse-ratio test.

Summarizing the present experiment as a whole, it is realized that while only restricted generalizations are possible due to the limited number of cases, the close agreement between the recalculated coefficients from Flanagan's data and the values obtained in the present experiment indicate that the final limits of relationship arrived at probably approximate the true values.

SUMMARY

The cardiac efficiency of twenty-eight male subjects was tested by the pulse-ratio method, and their endurance (defined as their ability to maintain on a relatively long sprint run the speed they had established on a short sprint run) was measured. Endurance therefore served as a criterion for validating the pulse-ratio test. Two methods of estimating endurance were used. The first employed an endurance index obtained by dividing the time scores of the long run by the time scores of the short run. The second utilized the time scores on the long run, and held statistically constant (through the use of the technique of partial correlation) the influence of speed as determined by the time scores on the short run.

Endurance was also estimated by timing the subjects while they climbed a flight of 36 steps, and the data thus obtained were used as validating criteria, both separately and in combination with the data obtained in the runs. In addition, the subjects were tested with a hand dynamometer, both as to their initial strength and their muscular endurance.

The data were statistically investigated in detail, and an analysis was made of the theoretical and empirical significance of the results.

CONCLUSIONS

1. The existence of a correlation of approximately —.50 reported by another investigator to hold between scores on the pulse-ratio test

of cardiac efficiency and a ratio index of endurance, based on the ability to maintain on a 220-yard run the speed a subject has established on a 60-yard run, is confirmed.

2. It is necessary to equate the work done in the pulse-ratio test in order to secure this degree of validity, if the subjects vary considerably in weight.

3. The correlation of —.89 obtained between these variables by another investigator using selected data, is of doubtful significance.

4. The evaluation of endurance through the use of the ratio of the time scores on a long and a short run is theoretically, and to some degree experimentally, unsound. The speed factor is not eliminated by this technique.

5. The pulse-ratio test correlates approximately —.46 with endurance in sprint running when the influence of speed is held constant by the partial correlation technique. When speed and weight are held constant, the correlation is —.42.

6. The pulse-ratio test has validity of approximately —.64 when the criterion is composite endurance in running and step-climbing. The validity drops to —.44 when the effect of weight is held statistically constant. The true validity is probably intermediate between these values.

7. General muscular endurance is probably not a determining factor in the pulse-ratio test. Initial strength may be a small positive factor.

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The Status of Physical Education in the Accredited Secondary Schools of Illinois

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INTRODUCTION

THE study was instituted and partially financed by the Illinois State Physical Education Society, and was carried on with the assistance of the following committee: Frances Etheridge, Southern State Teachers, Carbondale; Dora Sharpe, Western State Teachers, Macomb; and Lela Trager, Northern State Teachers, De Kalb.

PURPOSE

The purpose of the study was to secure information relative to the present practices in the conduct of the curriculum of physical education in the accredited secondary schools of the state. The factor of expense made it impossible to include all of the schools, both accredited and nonaccredited. It was hoped that the data which might be secured would be helpful in aiding the State Curriculum Committee to construct a tentative curriculum for all schools in the state.

PROCEDURE

Inquiry blanks were sent to the principals of the 736 accredited high schools listed in the Report of the Committee on Admissions from Secondary Schools, University of Illinois, 1935. A short letter, explaining the purpose of the study and limiting its scope to the curriculum in physical education, was enclosed, along with a stamped and self-addressed envelope.

DISCUSSION

Schools returning the inquiry blanks were grouped according to enrollment as follows: I—up to 50; II—50 to 100; III—100 to 250; IV—250 to 500; V—500 to 1000; VI—1000 to 2000; VII—over 2000.

A number of blanks were not checked completely, or were filled out so certain items could not be included in this present summary. The total responses, therefore, vary from table to table; and within the tables the sub-totals do not always equal the total. While most of the tables which follow are self-explanatory, the essential facts which they contain will be mentioned briefly. After the summary, the typical high school will be described in order to have a clearer picture of the average situation. Finally, the implications arising from the study will be presented.

The data secured appear to be significant since 543 principals, representing approximately 73 per cent of the accredited schools in the state, responded by filling out and returning the blanks. A recent survey which included personal visitation as a follow-up to inquiry blanks, however, revealed marked discrepancies between the information received and the conditions as they actually existed.[1] In every instance, the theoretical or "paper" picture was much closer to the ideal goals. In the present study, there was no practical way of checking the reliability of the answers, so that although the inquiry blanks may in some instances picture theoretical conditions, the data on the whole must necessarily be accepted as reasonably accurate.

Following is a copy of the letter sent to principals from the Bureau of Research, College of Education.

To Principals of Accredited High Schools in Illinois:

In cooperation with a committee of the Illinois State Physical Education Society, the Bureau of Educational Research is attempting a study of the status of physical education in the high schools. Will you assist us by describing the conditions and practices in your high school by checking or filling in the appropriate items on the enclosed blank? In case you are in doubt concerning the response to make, please consult your director of physical education, or your teachers in that field. The back of the sheet may be used for supplementary comment.

For the purpose of this study, the term "physical education" refers ONLY to the curriculum phase or the teaching of the in-school activities of the program, and does not include coaching or supervising varsity athletics in an extracurricular or out-of-school program. While it is entirely possible that special classes in health education may form part of the curriculum in many schools, this study does not request information in this field.

Dr. S. C. Staley, Director of the School of Physical Education, endorses the study as one of real worth, and I, therefore, feel justified in urging that you give this request for information prompt and careful attention.

Thanking you for your cooperation, I am,

Sincerely yours,

Walter S. Monroe, *Director.*

Committee of the Illinois State Physical Education Society: Frances Etheridge, Southern Illinois State Teachers College; Dora Sharpe, Western Illinois State Teachers College; Lela C. Trager, Northern Illinois State Teachers College; C. O. Jackson, University of Illinois.

THE INQUIRY BLANK

Status of Physical Education in the High School

School..... Enrollment..... Boys..... Girls.....

Please read the following statements *carefully* and answer each one specifically as it applies to your own situation. Check, or fill in the correct items. See accompanying letter for explanations.

1. Is physical education required? Yes ☐ No ☐ For: eight semesters ☐ six semesters ☐ four semesters ☐ two semesters ☐ daily ☐ four times a week ☐ three times a week ☐ twice a week ☐ less ☐ Length of periods (exclusive of showers and

[1] W. W. Brown, et al., "Survey of Physical Education in Twenty High Schools in Illinois." (Unpublished.)

dressing) 60 minutes ☐ 45 minutes ☐ 40 minutes ☐ 35 minutes ☐ 30 minutes ☐ less ☐

2. Do you grant credit for physical education toward graduation? Yes ☐ No ☐ 4 units ☐ 3 units ☐ 2 units ☐ 1 unit ☐ less ☐ Do you require varsity players to attend and participate in physical education classes? During the season ☐ After the season ☐

3. Do you have a program of intramural sports? Yes ☐ No ☐
For boys ☐ What sports?.....
For girls ☐ What sports?.....
Do you have a program of interscholastic sports? Yes ☐ No ☐
For boys ☐ What sports?.....
For girls ☐ What sports?.....

4. Do your teachers of physical education follow a curriculum outline (course of study)? Yes ☐ No ☐ Is this a state syllabus? Yes ☐ No ☐ .... ☐ For boys ☐ For girls ☐

5. How many teachers are members of the American Physical Education Association?..... Illinois Physical Education Association?.....

6.

Teachers	Degree	Institution	Semester hours of training in P.E.	Hours per week in P.E. classes	Hours per week in other subjects
Men					
Women					

7. What is the source of funds for physical education?
Board of Education ☐ Athletic fund ☐ ..... ☐
What is the approximate amount of money available for supplies and equipment each year in physical education?.....

8. What type of gymnasium do you have? Regulation ☐ Auditorium-Gym ☐ ..... ☐ How many periods a week during the school day is this available? ( ) For boys ( ) For girls ( )

Thank You for Your Interest and Cooperation

The Organization of the Curriculum in Physical Education.—Four hundred sixty-four schools, or more than nine-tenths of those responding (approximately 85 per cent), indicate they require physical education of all students (Table I). Three hundred eighteen schools, or two-thirds of this group, list a requirement of eight semesters, or the equivalent of the entire four years of high school. It is quite probable that a number of the schools which require physical education for six semesters are senior high schools in a junior-senior high plan, and consequently are only concerned with the students for the period of those six semesters. The largest percentage of schools which state they do not require physical education are in the two groups with enrollments ranging from 100 to 250, and 250 to 500. In the first group, we find approximately 15 per cent while approximately 18 per cent follow the same policy in the next group.

A majority of these schools, more than 72 per cent, indicate two meetings weekly of their classes in physical education, while slightly over a hundred list at least three meetings. It is interesting to notice that only 13 schools have daily periods devoted to this field, the majority in

schools with less than 500 pupils, and 37, or 8 per cent have one period, or even less for the same purpose. In this last grouping, 30 per cent of those with less than minimum requirements are in schools ranging in size from 50 to 250. It is entirely possible that in some schools where a required course in health education is also included, the students may meet one or more periods a week in the physical education classes, and one or more periods in the health education classes. This is the situation among a number of progressive schools in other states.

More than a third of the schools which stated they required physical education indicate periods of approximately 40 minutes in length, exclusive of dressing and showers. Only 45 schools, or approximately 10 per cent, most of them in schools with an enrollment from 50 to 250, devote an hour period. Twenty-one schools go to the opposite extreme, and list periods of less than thirty minutes as the practice.

School Policies and Professional Affiliation.—More than one hundred schools failed to reply completely to this group of questions, but a clear majority who did so indicate a trend toward granting credit for participation in the curriculum in physical education. One credit appears to be the usual amount to be earned for the entire school period, although a number indicate they allow less than this. In general, the larger the school the more apt the policy is toward awarding credit. Only ten schools indicate two units as the requirement. (Table II.)

Less than half the schools, 40 per cent, indicate they follow a policy of permitting students to substitute playing on varsity teams for participation in the curriculum in physical education. While a majority of the schools with enrollments of from 100 to 1000 excuse their athletes, almost three times as many of the schools with an enrollment between 100 and 250, and all of the large schools which responded to this question *did not* do so. However, in most cases where the athletes are excused, it is apparent that the policy is to require them to report to the classes in physical education when the season is finished. In one hundred and eleven schools, athletes are excused for the entire semester and may receive credit in physical education as well as satisfy the graduation requirements through participation in some or all of the varsity sports! Most of the schools which follow this practice are in the groups ranging in size from 250 to 1000.

Approximately half of the schools state they have a curriculum outline for physical education which, in most cases, is a state syllabus. The chief purpose of any state syllabus is merely to suggest better practices and procedures, and seldom if ever is it intended as a satisfactory curriculum for a specific situation. Data from other sources, as well as personal observation, suggest that the majority who indicate they follow a curriculum outline prepared by the state actually should have given a negative answer. Of 264 who did answer in the affirmative, only 21 schools said this was a special curriculum for their own situa-

TABLE I

ORGANIZATION OF THE CURRICULUM IN PHYSICAL EDUCATION

School	Required		Semesters					No. of Weekly Meetings						Length of Periods					
	Yes	No	8	6	4	2	Less	5	4	3	2	1	Less	60M	45M	40M	35M	30M	Less
I	17	4	17	1	0	0	0	0	0	1	14	0	3	1	4	4	2	2	1
II	128	19	107	1	14	2	1	2	0	15	87	0	13	11	16	40	20	28	5
III	171	30	108	4	46	1	10	2	0	24	135	2	12	12	32	60	30	33	8
IV	58	6	31	5	22	0	0	4	0	9	42	0	13	13	9	17	14	9	0
V	33	5	19	2	9	2	0	1	2	6	19	0	3	4	15	7	1	4	2
VI	24	3	9	4	10	3	0	2	0	5	17	0	1	3	9	5	5	4	1
VII	33	2	27	3	0	1	0	2	0	12	20	0	0	1	7	10	7	5	4
Total	464	79	318	20	101	9	11	13	2	72	334	2	35	45	92	149	79	85	21

TABLE II

SCHOOL POLICIES AND PROFESSIONAL AFFILIATION OF TEACHERS

School	Credits		Units			Athletes Excused				Curriculum Outline		Member of	
	Yes	No	2	1	Less	Yes	No	Season	Semester	Yes	No	I.P.E.A.	A.P.E.A.
I	5	12	0	6	0	1	7	10	0	8	9	1	0
II	34	19	0	28	7	17	41	75	16	56	83	15	4
III	89	104	3	63	25	133	52	116	67	81	116	40	15
IV	37	26	2	25	8	38	20	49	19	43	13	36	27
V	26	11	2	17	6	22	9	22	19	23	13	25	14
VI	18	8	3	7	8	6	6	0	0	22	1	22	38
VII	28	4	0	25	6	0	13	12	0	31	2	60	48
Total	237	184	10	171	60	217	148	284	111	264	240	199	146

tion. The data show quite definitely that less than 4 per cent of the accredited schools in the state actually have a curriculum outline for the local situation. No information was secured as to how many of these actually followed their outlines.

The picture presented in the table is not accurate as far as the question of the professional affiliation of teachers is concerned. A number of the principals who responded confused the State High School Coaches Association with the Illinois Physical Education Society, because the total memberships listed in the table exceeded the actual number of members in the latter organization at the time the study was carried on. It remains a sad commentary on the state of morale in our profession when we find only 15 per cent of the teachers in accredited schools members of state or national organizations in the field!

TABLE III

INTRAMURAL SPORTS

School	Boys									Girls						
	Basketball	Softball	Volleyball	Track	Baseball	Table Tennis	Football	Tennis	Swimming	Basketball	Volleyball	Softball	Tennis	Soccer	Table Tennis	Hockey
I	7	1	3	2	2	1	0	9	0	5	3	2	0	2	0	0
II	72	26	54	24	21	13	0	0	0	47	30	16	0	9	18	0
III	130	54	39	31	44	9	18	22	0	95	35	56	16	9	7	6
IV	52	22	19	15	2	10	10	7	4	34	23	20	13	11	1	10
V	32	4	7	9	10	4	7	5	5	23	19	10	7	9	0	6
VI	26	17	9	15	0	0	0	0	4	19	17	13	9	0	1	0
VII	33	27	13	14	0	0	0	0	19	22	25	22	9	0	0	0
Total	352	151	144	110	79	37	35	34	32	245	152	139	54	40	27	22

Intramural Sports.—While it was not the purpose of this study to survey practices in the program in extracurricular sports, two questions concerning this program were included in order to secure a more adequate picture of the situation in the schools. (Table III.)

As might be expected, basketball is by far the most popular intramural sport for boys judging by the number of schools which indicate it as part of their out-of-school program. Less than half of this number list softball, and then in close succession are volleyball, track and baseball. Football as listed in the table undoubtedly refers to touch or tag football. Tennis appears to be a popular sport in the small schools of enrollments from 100 to 250, and swimming, although a splendid activity, is found only in the large schools. This, of course, is because the expense connected with the construction and maintenance of swimming pools prohibits installation in very many schools.

Boxing is offered in 20 schools, about half of them large schools with enrollments over 1000. Horseshoes and handball are in the program of eight schools (250-500 enrollment) while badminton is offered in four cases. Shuffleboard, golf, and wrestling are listed in only one or two schools.

It is quite apparent that the majority of the activities listed in the first half of the table are team sports and those emphasized most are the varsity sports.

The second half of the table which includes intramurals for girls indicates that the most popular sport here also is basketball, although less than half of the schools responding offer it. The game is probably played with girls' rules in the majority of cases. Volleyball, softball, tennis, and soccer follow in rapidly diminishing frequency. Softball and baseball are quite likely the same activity and so might be considered next to volleyball in popularity. The schools which offer table tennis are almost entirely from the group of smaller schools (100 to 250 enrollment), and those which include hockey from the middle groups (250–500). The situation with respect to swimming is, as might be expected, exactly the same as for the boys, i.e., only the larger schools have facilities for this sport.

Seventeen schools list archery as a sport, while thirteen indicate track, nine golf, and five badminton. Archery is found in the group having enrollments of 250 to 500, while track is offered in smaller schools. Handball, hiking, dancing, shuffleboard, horseshoes, and tumbling are listed by only a few schools.

Apparently most of the activities which the girls engage in might quite logically be classified as leisure-time sports.

Interscholastic Sports.—Basketball remains king of all sports in the state with 80 per cent of the schools listing interscholastic teams in the sport. Track is second and football a poor third. Baseball has lost some of its popularity to track, due undoubtedly to greater cost of equipment, greater space requirements, more participants required, and the shorter spring season. It is listed fourth with less than half as many schools indicating the sport as listed basketball. The surprising thing is the lack of emphasis on such worth-while sports as tennis, golf, and wrestling. Without question, lack of a pool limits the swimming competition to only a few of the larger schools but most schools either have the facilities or can secure access to those necessary for the conduct of many other sports. (Table IV.)

Checkers is listed as a sport in one large school. Whether this is a varsity sport, a minor sport, or was listed merely as a joke, cannot be determined from the inquiry blank. There is every reason to suppose, however, that in the years to come there will be increasing emphasis on a wider variety of activities.

As might be expected with the present rules of the Girls Athletic

Association, there is no interscholastic program offered girls.

Degrees of Teachers.—More than a third of the teachers (437) in the schools participating in the study are listed as having a Bachelor of Science degree, while approximately a fourth have Bachelor of Arts degrees. A majority of this latter group, or 161, are women. The Bachelor of Education degree is listed third, while 76 teachers—50 men and 26 women—indicate Master's degrees. (Table V.)

In data not included in the table, five teachers were listed as possessing Ph.D. degrees, but a close scrutiny of the inquiry blanks, as well as further study of the School Directory for 1936–37, reveals all too clearly that these degrees are in other fields, and that in every case, physical education is merely a second or third "side line." A number of teachers in the state possess only two-year certificates, and a few others have never taken any university work, but this was not indicated a sufficient number of times to list in the table.

In spite of the fact that no subject may be taught in the accredited high schools of the state unless the instructor has a minor in that field,

TABLE IV
INTERSCHOLASTIC SPORTS FOR BOYS

School	Basketball	Track	Football	Baseball	Tennis	Softball	Golf	Swimming	Wrestling	Fencing	Soccer	Boxing	Rifle
I	13	3	0	9	0	9	0	0	0	0	0	0	0
II	111	65	15	49	10	39	0	0	0	0	0	0	0
III	169	116	71	74	17	28	4	2	1	0	0	0	0
IV	49	48	51	19	13	5	7	1	0	0	1	0	0
V	34	31	33	8	14	0	12	5	3	0	1	0	0
VI	27	26	27	13	18	0	17	10	3	0	0	1	0
VII	32	22	27	28	17	0	18	29	8	6	2	1	1
Total	435	311	224	200	89	81	58	47	15	6	4	2	1

TABLE V
DEGREES OF TEACHERS

	Men					Women				
School	B.S.	A.B.	B.E.	M.A.	B.P.E.	B.S.	A.B.	B.E.	M.A.	PH.D.
I	5	3	8	2	0	6	5	3	1	0
II	47	39	30	8	0	33	47	22	2	0
III	84	59	34	22	2	56	64	22	14	0
IV	29	19	9	7	0	24	18	6	1	1
V	14	9	4	5	0	11	12	4	1	1
VI	18	12	0	0	0	17	18	0	0	0
VII	55	4	3	6	18	42	7	2	7	11
Total	252	145	88	50	20	185	161	59	26	13

and has secured preparation from an institution of higher learning in the same temporal and territorial ranges which are covered in the particular high school course taught,[2] more than one-third of the instructors are listed as lacking sufficient training to meet even the first requirement. Forty-one of these indicate no training whatsoever, mainly in the smaller schools (100–250) while 88 have had less than five hours preparation. A recent study of men teachers in physical education, covering all the schools in the state, both accredited and non-accredited, confirms this with data indicating that "in schools with an enrollment of less than 100, and also in many schools with an enrollment up to 250, it is quite obvious that the person who is coaching or teaching physical education has had very little preparation in this subject. . . . "[3] The actual picture may possibly be worse than the present data indicate.

Almost half of those listed as instructors of physical education devote five hours or less per week to instruction in this field, while the great bulk of their teaching is in one or more of the academic fields. About a third spend from six to ten hours weekly teaching physical education and less than fifty spend as much as fifteen hours teaching in this field. In the small schools, "The teacher must teach a great variety of subjects in a number of specific fields [and] . . . the subject combinations are so scattered and so unusual that it becomes difficult to secure adequately trained teachers to fill them. . . . "[4] Sixty-nine instructors, the majority in the larger schools, devote full time to teaching physical education and coaching sports, while thirty-five schools give the impression that their instructors do nothing but coach varsity teams.

Funds for Physical Education.—While the data in Table VI are inadequate because a number of schools did not answer, or merely stated they "didn't know," the larger the school, apparently, the larger the budget. This does not necessarily mean that such a school has sufficient money for the needed equipment, since the enrollment is larger in proportion. In most schools, equipment purchased through the athletic association, such as basketballs, footballs, etc. is commonly used by the classes in physical education so the funds indicated may not present a true picture of the situation. The Board of Education supplies the funds for the curriculum in physical education in more than half of these schools, while about a fourth depend on the athletic association directly.

SUMMARY

In interpreting the data as presented in the preceding tables, it must be remembered that while the study presents data from 73 per cent of

[2] "The Recognition and Accrediting of Illinois Secondary Schools," *University of Illinois Bulletin* 34:10 (Oct. 1936), p. 19.

[3] C. O. Jackson, "A Study Showing the Subjects Taught by Men Teachers of Physical Education in the State of Illinois," (1936–37) Mimeographed, p. 6.

[4] *Ibid.*, p. 6.

the accredited schools of the state, less than half of all the schools in the state (approximately 1150) were actually studied in this survey. In other words, only data from the better schools were secured. It seems logical to assume that conditions in the nonaccredited schools are no better than in those responding, and undoubtedly in all too many instances, much worse.

More than four-fifths of the accredited schools responding report a policy of requiring physical education of all students. Slightly more than half list a requirement of eight semesters and give credit. The majority indicate two meetings a week of their classes. More than one-third indicate forty-minute periods, exclusive of dressing and showers. A few schools, forty-five in all, have periods of one hour in length while twenty-one have periods of less than thirty minutes.

In about 40 per cent of the schools, varsity athletes are excused from the curriculum in physical education. More than half of the schools require athletes to attend classes in physical education after the season in which they are competing, while a fourth excuse them the entire semester.

Approximately half of the accredited schools are reported as using a curriculum outline for physical education. However, only twenty schools indicated that this was a special syllabus for the local situation.

Only 15 per cent of more than one thousand teachers of physical education in the schools responding are members of either state or national physical education associations.

The intramural program occupies a prominent place in most schools. Basketball leads as the most popular intramural sport for boys as well as girls. Among the boys the varsity team sports are emphasized, while with the girls, individual leisure-time sports seem to predominate.

In the program of interscholastic sports for boys, basketball ranks as the most outstanding. The surprising thing is the lack of emphasis on such worth-while sports as tennis, golf, wrestling, and others of a similar nature.

There is a decided need for trained teachers in the field of physical education. While more than one-third of the instructors are listed as not meeting the state requirements for teaching this subject in accredited high schools, the actual figure is probably much higher. Forty-one who reported indicate no training whatsoever. Eighty-eight had less than five hours preparation.

The majority of teachers in the accredited schools spend less than five hours in this field and approximately twenty-six hours, exclusive of coaching, each week, teaching academic subjects.

The Board of Education in approximately half of the schools appropriates a maximum of $100 annually for the conduct of the curriculum in physical education.

TABLE VI

FUNDS FOR PHYSICAL EDUCATION AND SOURCES

School	Funds for Physical Education									Sources of P.E. Funds		
	$0–25	$26–50	$51–75	$76–100	$101–150	$151–200	$201–300	$301–400	$401–600	$600–Over Needs	Board of Education	Athletic Funds	Combination
I	1	4	0	1	5	1	0	0	0	2	14	12	3
II	38	24	3	6	13	10	3	0	0	14	129	67	3
III	26	31	10	34	8	13	11	3	4	2	0	0	0
IV	2	11	1	6	6	7	6	2	2	30	54	23	0
V	1	3	0	5	1	5	4	2	2	5	24	3	3
VI	0	0	1	0	4	0	2	1	0	8	26	11	0
VII	0	0	1	0	1	0	2	0	0	0	32	21	0
Total	68	73	16	52	38	36	28	8	8	33	46	279	136	9

THE TYPICAL HIGH SCHOOL

This school, as pictured from the data secured in the present study, has an enrollment somewhere between 100 and 250 students, requires physical education in a regulation gymnasium of all its students for eight semesters, gives one-eighth credit per semester, and requires attendance at two forty-minute periods weekly (exclusive of dressing and showers). The curriculum in physical education is administered by an instructor who has a B.S. or A.B. degree and a major in one or more academic fields. He probably has less than the required preparation for an acceptable minor in the field of physical education and is not a member of either state or national organizations which promote health and physical education. This instructor may or may not follow a curriculum outline, but if he does, this is nothing more than a state syllabus which may possibly serve as a general guide. Varsity athletes are excused from attending the classes in physical education, and the emphasis in both the program in intramurals and interscholastic sports is on basketball. This curriculum is carried on with the help of $50. to $75. which the Board of Education furnishes, and some equipment which is no longer suitable for varsity games or practice.

IMPLICATIONS

If physical education is to make a definite contribution to the health and education of the students in the schools of Illinois, the school authorities must place definite emphasis on improved curricula administered by adequately trained teachers.

The professional objectives adopted some time ago by the American Physical Education Association, now the American Association for Health and Physical Education, might well be considered as goals.

1. A medical examination for every school child.
2. Health habits that endure.
3. A class period in physical education each day.
4. A gymnasium and playground for every school.
5. A teacher fully trained and accredited.
6. The coach a member of the faculty.
7. A graded and scientific curriculum.
8. Standard physical efficiency tests.
9. Positive credit for physical education activities.
10. Education for leisure.
11. An intramural program for after-school hours.
12. A varsity program that stresses sportsmanship and ethical conduct.

Two other factors which would contribute materially are as follows:

1. The state Department of Public Instruction should enforce the present state law pertaining to time requirements, facilities, and training of teachers in physical education, and
2. The University of Illinois should emphasize the need for all accredited

secondary schools to meet the present requirements for recognition and accrediting. These are:

"A course in physical education may be recognized and accredited under the following conditions:

a) The course must be well organized and graded and must be designed to meet the needs of the pupils enrolled.

The department of physical education must formulate and follow a curriculum outline designed for its own use.

The curriculum must cover a minimum of twelve activities selected from the list . . . or others similar. A minimum of six clock hours should be spent on each activity.

Students in all classes should be dressed in appropriate costumes.

Students should be expected to take a shower after each class.

b) The classes in this subject must meet at least twice each week during class periods not less than forty minutes in length. The curriculum must extend over a period of six semesters in a three-year senior high school and over a period of eight semesters in a four-year high school.

c) Credit will be estimated on the basis of a total time allotment of 240 sixty-minute hours for one unit of credit.

d) The school must be so equipped as to meet the needs of instruction in this subject.

e) The minimum requirements of a teacher relative to preparation shall be a college degree, and at least sixteen semester hours of college preparation in physical education.

f) The maximum amount of credit which may be allowed is one unit.

In order to receive credit for a course in physical education, the student must have been enrolled in a regularly scheduled class and should not be permitted to substitute "varsity squad" participation for the activities as outlined . . . in the physical education class. . . . "[5]

Acknowledgments.—The study was made possible and more comprehensive through the cooperation and advice of Dr. W. S. Monroe, Director of the Bureau of Research, University of Illinois, who assisted in the development of the inquiry blank and also sent out the letters and blanks from his office. Special mention should also be made for the assistance received from the following:

The principals of 543 senior high schools in the state of Illinois for their courtesy and cooperation in filling out and returning the inquiry blanks; Dr. S. C. Staley, Director of the School of Physical Education, University of Illinois for advice and encouragement; Mr. Le Roy Knoeppel, Superintendent of Schools, Hamilton, Illinois, for the opportunity to read his master's thesis, "A Critical Survey of the Physical Education Program of Certain Illinois High Schools (1934)"; and J. Frank, D. Garwood, W. Hapac and L. Stasica, University of Illinois students and N.Y.A. assistants, for help with the tabulation.

[5] "The Recognition and Accrediting of Illinois Secondary Schools," *University of Illinois Bulletin* 34:10 (October 2, 1936), 25–26.

A Further Study of Recreational Therapy

By Jane Hunt, Kenneth Ashcraft, Granville B. Johnson
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PROBLEM

FOR a number of years the director of the Psychopathic Hospital of the University of Colorado School of Medicine has concurred with the directors of similar institutions in other parts of the country in the belief that a program of recreation designed for patients suffering from mental diseases could conceivably be a valued supplement to the therapeutic techniques already employed. However, uncontrollable situations prevented any definite attempt in this direction. In the early part of 1936 the Department of Physical Education of the University of Denver was invited to make a study of the problem with the hope of being able to shed more light upon certain obscure features and perhaps prove or disprove the validity of this belief.

The problem may be crystallized and presented under the following headings:

1. To devise, develop, and present a program of recreational activities graded and suited to the needs of persons afflicted with disorders of the central nervous system.

2. To observe and perhaps measure improvements if and when they occur.

3. To develop a teaching technique primarily designed for learners of this type.

MATERIAL AND EQUIPMENT

The equipment at the present time might be said to be quite inadequate, that is, no such wealth of paraphernalia as is described by Davis and Dunton was available.[1] For instance, the Hospital is not equipped with a gymnasium or recreational hall, neither is there a swimming pool nor squash or handball courts. However, the plant is surrounded by spacious lawns where games of various sorts are played. There are also tennis courts and a softball diamond. The experimenters were supplied with adequate balls, bats, nets, and similar paraphernalia. There is an excellently equipped and administered occupational therapy department (independent of our efforts). At the present time there is under construction a new unit that will include complete equipment for an elaborate recreational program.

[1] *Principles and Practice of Recreational Therapy for the Mentally Ill,* (New York: A. S. Barnes and Co., 1936).

SUBJECTS

There were 150 patients, about equally divided as to sex, ranging in age from 15 to 65 years. These people presented samples of nearly every type of mental disorder. However, it is significant to note that all of them participated to some extent in the program, as presented.

METHODS OF PROCEDURE

A study was made of the basic characteristics of the various mental disorders. This consumed considerable time but was necessary to understand properly the fundamental psychological differences of these abnormal people. A program of activities was then developed, which was presented in three periods per week. These periods were sixty minutes long. Only those activities were used which gave the maximum promise of therapeutic value. Such factors as age, sex, intelligence, physical condition, and the facilities which the investigators had at their command had to be taken into account. Also such items as the past play experience, the economic background, and the occupation of the patient and other individual differences needed to be considered. It was soon apparent that the methods used in presenting material to normal individuals was quite inadequate for people suffering with mental diseases. A new technique of teaching had to be developed which included such changes as placing greater stress upon the "art" of exposing the essential elements of the skills involved. Also, it was found to be necessary to devote more time to practice or repetitions than in ordinary cases. The teachers of these groups must exercise greater patience and develop a more understanding attitude than is required in other situations. Praise and blame played a tremendously important part in the teaching procedure and had to be used with the greatest of skill. The real strength of the program, it is felt, is to be found in the incidental or concomitant values that accrued. That is, the parallelism of situations on the playing field and similar situations in other life conditions had to be subtly pointed out. The investigators attempted to develop in certain cases active attitudes in the face of difficulties. Frustrations and disappointments were shown to have but relatively little weight in the course of the game or contest and it was demonstrated that these obstacles could be surmounted by developing a determined attitude. We were often rewarded by evidence of new self reliance and independence in thought and action in patients who previously showed little interest in life in general.

SECURING AND HANDLING THE DATA

A complete record was made for each patient; this included his age, physical condition, type of mental disorder, his reactions to the activity, to the group, and the teacher. A record was also made concerning his

appetite for food, how he rested and slept, his behavior in the ward, his attitude toward his fellows, himself, and his world in general. These data had been assembled with the hope that they might lend themselves to statistical procedure, thus producing concrete evidence on which to base our conclusions. This has, however, proved to be impractical for the following reasons:

1. There have been too few specific cases for statistical treatment.

2. Patients are not committed to the hospital for any definite length of time. They are discharged or transferred to other institutions as and when their cases indicate.

3. There has been no objective test developed that could accurately and adequately measure the effects of our efforts.

4. Mental diseases vary in intensity in different individuals, such factors as age, economic and social experience playing an important part in the degree of this intensity.

CONCLUSIONS

1. The following conclusions are based upon the individual case records and upon the judgment of the hospital staff; that is, the nurses, the supervisors, the head nurse, and the doctors. It is felt that the opinions of these people might be called expert. They based their judgments upon the evidence of total reactions; i.e., patients who participated in the program had better appetites for food; they slept longer and more soundly; they seemed more cheerful in the wards; and many developed new interests and enthusiasms. Nearly all of them looked forward to the coming of the recreational hour.

2. As a control group there were certain patients who, for various reasons, could not take part in the program; it is worthy of note that these individuals did not evidence the improvements observed in the members of the experimental group.

3. The subjective evidence at hand seems to indicate that a program of recreational therapy, intelligently prescribed and skillfully presented might have considerable therapeutic value for patients suffering from certain mental maladies.

For instance, it was noted, in the main, manic-depressives were helped considerably by more or less vigorous team games during the manic period, while well planned self-testing activities produced good results while the patient was depressed. It is during this depressed state that the skillful teacher uses praise and encouragement following achievement.

With the person with the hysterical constitution, activities of a quiet type in which the competitive element had been reduced were found to be helpful and offered a definite outlet for pent-up emotions.

The alcoholic showed evidence of improving his general well being when participating in a program of his interest.

It is with the schizophrenic that physical and recreational education has its greatest opportunity for mental therapy. This little known disease appears early in childhood and often is superinduced by some handicap, real or imaginary, that thwarts a desire or inclination. Inconsiderate or brutal treatment at home, in the school, or in the gymnasium may be the factor which initiates the disease. On the other hand, evidence at our disposal seems to demonstrate the possibilities of improvement when a physical-recreational program is intelligently offered. Such a program would include self-testing activities that might develop confidence in self and offer an opportunity for self expression. The patient then develops faith in himself and sees achievement in reality instead of in the realm of fancy. It is but a short step then to demonstrate to the individual that he may expect success in other forms of activity. There have been patients who advanced to the stage where they played for the first time in their lives in team games of low organization and conducted themselves with credit. It was pointed out to them that later and other life situations were but other manifestations of a game.

With the paretic, because of the pathology caused by the syphilis germ producing permanent destruction of nervous tissue, the chief value of any form of exercise was in the improvement of the general physical condition.

It is worthy of note that the major portion of the patients suffering from mental diseases did not show a history of a normal play life. In fact, it may be said that many of them could trace their difficulties to the injudicious use of their leisure time.

A Critical Analysis of Test Elements Used in Physical Education

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EDUCATORS engaged in the construction and the validation of tests are frequently confronted by the query, "What does this test measure?" Authors of intelligence tests, because of the subjective and intangible nature of the functions they were trying to measure and the uncertainty regarding the true nature of the test items which they intended to employ, were the first to recognize the need for a method of analysis which would separate human abilities into their peculiar functional categories. Spearman in his book *The Abilities of Man* states this problem very clearly when he writes, "Every science whatever, physical no less than psychological, is obliged to dissect its subject-matter, to deal with the different aspects of it in succession, and finally to bring each of these into relation with all the rest. Only by first dividing can the scientist eventually conquer."[116]*

The field of testing in physical education is by no means exempt from these considerations. With the exception of tests of strength which undoubtedly are what they purport to be, it is impossible to state with any degree of precision the exact nature of the tests commonly employed at the present time. Similarly the analysis of performance in track and field events, gymnastic stunts, and game skills transcends comprehension on ordinary levels of thinking.

Psychologists in their efforts at intelligence test construction succeeded fairly well by devising test items which exercised the various thought processes involved in intelligent behavior and then combining into one test a large number of these test items. This same approach has been used by physical educators interested in the appraisal of physical performance. General motor ability is estimated from a battery including a short dash or the potato race, jumps for height and distance, a throw or put for distance, and a test of strength. General motor capacity is assessed by means of a battery which includes the Brace test of motor educability, the Burpee test for agility, the Sargent jump for

This is an excerpt of a thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Physical Education in the Graduate College of the State University of Iowa, 1936. Also presented before the Research Section of the National Convention of the American Physical Education Association at St. Louis in 1936.

* Indices refer to numbered Bibliography at the end of this article.

athletic power, and a combination of age, height, and weight, as an index of size and maturity.[7,10]

The introduction of tests of intelligence was followed by their widespread acceptance and use. Educators and clinical psychologists immediately recognized their value. Standardization of the various forms has led to a better understanding of their functions and limitations. Similar acceptance of, and confidence in, tests of general motor capacity and ability is not in evidence. This negative attitude is due not so much to the lack of appropriate tests as it is to the lack of training in their application and interpretation. Administratively, motor tests frequently involve more time and effort and present as many pitfalls as do mental tests. Consequently actual testing in physical education is not keeping step with the results of the research being done. Simplification and better understanding of these tests can be brought about by a clearer knowledge of what they measure. This information can, we believe, be furthered by a critical analysis of individual test elements in terms of their component parts.

The investigation herein reported is in spirit a pioneering effort and should be viewed as such. The techniques employed undoubtedly have weaknesses which will become apparent as time and research methods progress; but for the present we must accept them as they are. Further applications of the methods, will, we believe, simplify their understanding and use so that in the not too distant future they will take their places beside correlation techniques in the tool chests of research workers in educational fields.

STATEMENT OF THE PROBLEM

The first purpose of this study was to analyze statistically, for their common and group components, forty test elements devised for use in physical education classes for boys at the high school level. Thurstone's method for determining multiple factors was utilized for this analysis.[17,18,19]

The second purpose was to formulate combinations of items which would give high multiple correlations with the common components. If Thurstone's statement, that factor loadings represent zero-order correlations with the common components, continues to be substantiated by further research, then the regression weightings giving high multiple correlations with these criteria will be of value as instruments for diagnostic testing and for further research.

PROCEDURE

Collection of Data.—A battery of 40 separate test items was administered to 120 junior and senior high school boys. The testing was done as part of the regular testing program thereby ensuring maximum effort.

Multiple Factor Analysis.—Pearson product-moment correlations were obtained of each test against each of the others. These correlations were used as the foundation for the correlation matrix which became the data sheet for calculating the first factor loadings.

Commencing with the correlation matrix data sheet, Thurstone's simplified multiple factor method was followed to obtain the unrotated loadings for the first five factors.

The next step was to attempt to identify the factors by the distribution of the traits when plotted graphically and then in turn to find the correct solution for rotating the factorial matrix. This was done in the approved manner and equations for computing the true loadings were set up. Substituting the unrotated values in these equations gave values which represent the zero-order correlations of each item with each factor.

Partial and Multiple Correlations.—Using the final values obtained in the factor analysis as zero-order correlations of each test variable with each of the common factors, partial and multiple correlations were computed by regular formulas to determine combinations of variables which would give high multiple correlations with the criteria. Regression weightings were then computed for those combinations recommended for diagnostic and research purposes.

RESULTS

Multiple Factor Analysis.—Inspection of the fourth factor residuals indicated that the existence of a fifth common or group factor as such was quite dubious. If present, it would be so small that it would be difficult to identify and name with any degree of confidence. The fifth factor loadings were computed however and studied graphically in order to further test this opinion. It appeared probable that it was due to nothing more than chance variation and consequently the fifth factor loadings were omitted in the final analysis.

The raw factor loadings obtained by Thurstone's simplified method are tabulated in Table I. The first four factors will be referred to as the factorial matrix. The column headed "hypotenuse" gives the square root of the sum of the squares of the first four factors.†

The rotated loadings or zero-order correlations of each test with each of the four factors are presented in Tables II, III, IV and V, the items being arranged in order of size of factor loading. A study of the items at the top and bottom of each list provides the principle clues which reveal the identity of the factors.

Factor A, Table II, was identified as "strength." Strength Index[12] and Total Resistance Strength[6] top the list with factor loadings of .958

† The "communality" is defined as the sum of the squares of the factors. The hypotenuse represents the correlation of the variables with all of the factors and corresponds roughly to a multiple correlation.

and .950 respectively and two single tests, Chin Strength (McCloy's formula[9]) and Pectorals (a resistance strength test), come next with factor loadings of .942 and .928 respectively. Classification Index[8] as an index of size and maturity correlates very highly with strength and for

TABLE I

UNROTATED FACTOR LOADINGS AS OBTAINED BY THURSTONE'S METHOD OF MULTIPLE FACTOR ANALYSIS (THE FACTORIAL MATRIX)

Name of Test	No. of Test	Factors I	II	III	IV	V	Hypote-nuse
Total Baseball	1	.814	.202	—.256	.407	.104	.966
Fielding a Groundball	2	.459	.373	—.422	.299	.153	.786
Throwing a Baseball	3	.536	.153	—.417	.312	—.039	.763
Catching a Flyball	4	.610	.313	—.344	.272	.007	.814
Batting	5	.551	—.066	.023	.323	.196	.642
Circling the Bases	6	.865	.102	.240	.134	—.066	.913
Throwing a Soccerball	7	.471	.320	—.306	.085	—.151	.652
Catching a Soccerball	8	.623	.238	—.220	.249	.003	.745
Kicking a Soccerball	9	.687	.180	—.227	—.141	—.227	.759
Dodge Run with Soccerball	10	.784	.156	.121	.087	—.048	.813
Total Touch Football	11	.841	.301	—.228	.094	—.209	.926
Shooting Baskets	12	.696	—.024	—.393	—.122	.187	.809
Dribbling a Basketball	13	.600	.325	—.363	—.233	.234	.807
Basketball Target Throw	14	.597	.007	—.362	—.135	—.135	.711
Total Basketball	15	.777	.102	—.486	—.267	.084	.960
Johnson Test	16	.359	.459	—.171	—.503	.076	.788
Bar Vault	17	.842	.079	.247	—.020	—.034	.882
60-Yard Dash	18	.837	.080	.263	.106	—.121	.887
Potato Race	19	.812	.176	.127	.072	.126	.843
Standing Broad Jump	20	.872	.017	.273	—.079	—.044	.917
Running High Jump	21	.818	—.033	.117	—.010	.037	.827
Shot-Put (8 lbs.)	22	.902	—.236	.024	.013	.120	.933
Sargent Jump	23	.719	.196	.397	—.074	.165	.848
Brace Test	24	.492	.512	.183	—.288	.218	.787
Burpee Test	25	.541	.230	—.053	—.325	.076	.674
Pectoral Strength	26	.825	—.414	.101	—.042	—.037	.929
Arm Flexor Strength	27	.812	—.335	.272	.082	.029	.923
Thigh Flexor Strength	28	.673	—.323	.116	—.187	—.078	.778
Leg Extensor Strength	29	.693	—.417	.082	.350	.082	.813
Sum of Grip Strengths	30	.817	—.358	.217	.076	—.075	.922
Leg Lift	31	.765	—.391	.141	—.029	—.097	.871
Back Lift	32	.788	—.370	.195	.018	—.123	.892
Chin Strength	33	.834	—.428	.141	.040	.137	.948
Dip Strength	34	.760	—.512	.049	.023	.128	.918
Classification Index	35	.774	—.501	.068	.065	.167	.927
Physical Fitness Index	36	.353	.333	.276	—.096	—.476	.567
Motor Quotient	37	.249	.679	.292	—.187	.186	.802
Motor Achievement Quotient	38	.842	—.299	.057	.060	—.102	.897
Strength Index	39	.879	—.332	.216	—.083	—.147	.967
Total Resistance Strength	40	.827	—.435	.156	—.066	—.014	.950

this reason appears well up towards the top of the list with a factor loading of .910. Putting the shot, which is primarily a test of strength, also appears high on the list with a factor loading of .897. At the bottom of the list appear such items as: (1) Motor Quotient,[7] (2) the Johnson

Test,[8] and (3) Fielding a Baseball, which are obviously poor tests of strength.

Factor B, Table III, was identified as "velocity" or speed of movement. It seems reasonable that speed of movement should be one of the

TABLE II

ROTATED FACTOR LOADINGS FOR *Strength* IN ORDER OF MAGNITUDE: CORRELATIONS OF TEST ELEMENTS WITH THE FIRST COMMON FACTOR

Name of Test	No. of Test	r
Strength Index	39	.958
Total Resistance Strength	40	.950
Chin Strength	33	.942
Pectoral Strength	26	.928
Classification Index	35	.910
Sum of Grip Strengths	30	.906
Dip Strength	34	.903
Arm Flexor Strength	27	.900
Shot-Put (8 lbs.)	22	.897
Back Lift	32	.886
Motor Achievement Quotient	38	.875
Leg Lift	31	.871
Leg Extensor Strength	29	.805
Standing Broad Jump	20	.802
Thigh Flexor Strength	28	.766
Running High Jump	21	.748
Bar Vault	17	.740
Circling the Bases	6	.737
60-Yard Dash	18	.728
Potato Race	19	.642
Dodge Run with Soccerball	10	.625
Sargent Jump	23	.607
Total Basketball	15	.569
Shooting Baskets	12	.561
Total Touch Football	11	.551
Total Baseball	1	.546
Batting	5	.491
Kicking a Soccerball	9	.488
Basketball Target Throw	14	.466
Catching a Soccerball	8	.381
Burpee Test	25	.380
Dribbling a Basketball	13	.331
Catching a Flyball	4	.313
Throwing a Baseball	3	.307
Brace Test	24	.244
Throwing a Soccerball	7	.208
Physical Fitness Index	36	.207
Fielding a Groundball	2	.139
Johnson Test	16	.109
Motor Quotient	37	—.033

main factors limiting general motor capacity and ability. Consequently, some of the elements in the General Motor Capacity battery should appear well up toward the top of the list in Table III.

Motor Quotient, which is a direct function of the General Motor Capacity battery, heads the list with a factor loading of .781. The

Brace Test and the Sargent Jump[14] are next with loadings of .676 and .592 respectively. The Burpee Test ranks 13th with a loading of .350. These items are part of the General Motor Capacity battery. Physical Fitness Index[12] appearing fourth on the list with a correlation of .525,

TABLE III

ROTATED FACTOR LOADINGS FOR *Velocity* IN ORDER OF MAGNITUDE: CORRELATIONS OF TEST ELEMENTS WITH THE SECOND COMMON FACTOR

Name of Test	No. of Test	*r*
Motor Quotient	37	.781
Brace Test	24	.676
Sargent Jump	23	.592
Physical Fitness Index	36	.525
Circling the Bases	6	.473
Potato Race	19	.462
60-Yard Dash	18	.460
Bar Vault	17	.459
Standing Broad Jump	20	.435
Dodge Run with Soccerball	10	.433
Johnson Test	16	.424
Total Touch Football	11	.391
Burpee Test	25	.350
Running High Jump	21	.296
Dribbling a Basketball	13	.284
Total Baseball	1	.273
Catching a Soccerball	8	.267
Catching a Flyball	4	.259
Kicking a Soccerball	9	.259
Throwing a Soccerball	7	.249
Fielding a Groundball	2	.218
Strength Index	39	.130
Arm Flexor Strength	27	.125
Batting	5	.119
Shot-Put (8 lbs.)	22	.112
Total Basketball	15	.102
Sum of Grip Strengths	30	.081
Throwing a Baseball	3	.068
Motor Achievement Quotient	38	.057
Back Lift	32	.054
Thigh Flexor Strength	28	.027
Basketball Target Throw	14	.024
Shooting Baskets	12	.014
Chin Strength	33	.006
Leg Lift	31	.005
Total Resistance Strength	40	.000
Leg Extensor Strength	29	—.072
Pectoral Strength	26	—.013
Classification Index	35	—.121
Dip Strength	34	—.143

seemed at first to be out of place but after some deliberation was adjudged to be quite logically ranked. This index is obtained by dividing a person's actual Strength Index score by the norm for his age and weight, and is consequently a measure of excess muscular force beyond normal expectations. It would seem quite reasonable therefore, that individuals

with an excess amount of strength with which to overcome internal resistance and external inertia should be able to approach more closely their maximum speed or velocity of contraction.

TABLE IV

ROTATED FACTOR LOADINGS FOR *Motor Educability* IN ORDER OF MAGNITUDE: CORRELATIONS OF TEST ELEMENTS WITH THE THIRD COMMON FACTOR

Name of Test	No. of Test	r
Total Basketball	15	.758
Dribbling a Basketball	13	.672
Johnson Test	16	.612
Shooting Baskets	12	.557
Basketball Target Throw	14	.519
Kicking a Soccerball	9	.502
Total Touch Football	11	.490
Fielding a Groundball	2	.466
Throwing a Soccerball	7	.452
Catching a Flyball	4	.440
Burpee Test	25	.419
Throwing a Baseball	3	.404
Total Baseball	1	.335
Catching a Soccerball	8	.331
Brace Test	24	.300
Potato Race	19	.170
Shot-Put (8 lbs.)	22	.160
Motor Quotient	37	.158
Dodge Run with Soccerball	10	.153
Running High Jump	21	.143
Bar Vault	17	.090
Standing Broad Jump	20	.083
Thigh Flexor Strength	28	.077
Motor Achievement Quotient	38	.075
Circling the Bases	6	.044
Physical Fitness Index	36	.044
Pectoral Strength	26	.040
60-Yard Dash	18	.024
Strength Index	39	.012
Total Resistance Strength	40	.000
Dip Strength	34	.000
Sargent Jump	23	.000
Leg Lift	31	—.006
Batting	5	—.017
Leg Extensor Strength	29	—.018
Classification Index	35	—.025
Chin Strength	33	—.029
Back Lift	32	—.056
Sum of Grip Strengths	30	—.085
Arm Flexor Strength	27	—.124

Items at the bottom of the list which involve little or no "velocity" and consequently should have small factor loadings are: (1) the strength tests, (2) Classification Index, (3) Shooting Baskets, and (4) Target Throw.

Factor C, Table IV, was identified as "motor educability." This concept has been defined as the innate capacity to learn which manifests

itself in the degree of large-muscle coordination acquired after a reasonable amount of practice as well as in the ability to perform new movements relatively well with little or no practice. These two aspects of a single component must be kept in mind when studying Table IV. Total Basketball[4] heads the list with a loading of .758 and Dribbling a Basketball is second with a factor loading of .672. Shooting Baskets and Target Throwing with a basketball are fourth and fifth with loadings of .557 and .519 respectively. Practically all the boys tested, with the exception of a few varsity players, had received approximately the same kind and amount of training in the handling of a basketball and consequently the ability of each one was dependent to a large degree upon his motor educability. The Johnson Test ranks third in this list with a factor loading of .612. It was entirely new to the boys and therefore illustrates the second aspect of the motor-educability concept, namely, the ability to perform new movements with little or no practice. The Brace Test which is generally believed to measure this same factor quite well appears fifteenth on the list with a factor loading of only .300.* The only explanation we can offer is that in all probability most of the boys studied had had much experience with the Brace type of stunts prior to our testing them. This has been shown to invalidate the test as a test of motor educability because some of the items are easily learned after a few trials, whereas, the harder items such as a full pirouette in the air, the double heel kick, and jumping over the foot, all of which depend to a large degree upon velocity, are apt to be missed even after some practice has been given in them. (This partially explains why the Brace test correlates so well with the velocity factor.) Touch football and baseball tests with loadings between .331 and .502 all appear well up toward the top of the list. The Burpee Test of large-muscle coordination appears eleventh on the list with a loading of .419 which, in view of the fact that practice in performing it was given to all boys, makes it fit into the list quite harmoniously. At the bottom of the table are such items as: (1) Strength Tests, (2) Classification Index, and (3) 60-yard dash, which quite obviously are not significantly related to educability.

Factor D, Table V, was tentatively identified as sensori-motor coordination. Here again it is difficult to distinguish between two separate concepts because they manifest themselves simultaneously. It is possible to conceive of and call this factor sensori-motor educability or the innate capacity to learn to make sensori-motor adjustments. We prefer to call it sensori-motor coordination which, as a definite ability, is easier to understand and to fit into our factorial pattern. Total Baseball heads the list with a factor loading of .670 and Fielding Ground-

* Gertrude Barton, in her M.A. thesis, State University of Iowa, 1935, has presented evidence which indicates that the Johnson and Brace tests are measures of motor-educability.

balls, Throwing to First Base, and Catching Flyballs are second, third, and fourth in order with loadings of .577, .565, and .551 respectively. Batting with a factor loading of .396 ranks seventh. These baseball tests along with Catching a Soccerball with a loading of .479 and

TABLE V

ROTATED FACTOR LOADINGS FOR *Sensori-Motor Coordination* IN ORDER OF MAGNITUDE: CORRELATIONS OF TEST ELEMENTS WITH THE FOURTH COMMON FACTOR

Name of Test	No. of Test	r
Total Baseball	1	.670
Fielding a Groundball	2	.577
Throwing a Baseball	3	.565
Catching a Flyball	4	.551
Catching a Soccerball	8	.479
Total Touch Football	11	.402
Batting	5	.396
Throwing a Soccerball	7	.340
Circling the Bases	6	.255
Dodge Run with Soccerball	10	.243
Potato Race	19	.237
60-Yard Dash	18	.212
Motor Achievement Quotient	38	.173
Shooting Baskets	12	.172
Shot-Put (8 lbs.)	22	.166
Kicking a Soccerball	9	.135
Basketball Target Throw	14	.134
Running High Jump	21	.132
Classification Index	35	.123
Sum of Grip Strengths	30	.119
Total Basketball	15	.113
Arm Flexor Strength	27	.109
Bar Vault	17	.105
Chin Strength	33	.103
Dribbling a Basketball	13	.102
Leg Extensor Strength	29	.088
Dip Strength	34	.086
Back Lift	32	.065
Pectoral Strength	26	.043
Standing Broad Jump	20	.040
Leg Lift	31	.031
Sargent Jump	23	.000
Total Resistance Strength	40	.000
Strength Index	39	—.006
Physical Fitness Index	36	—.038
Motor Quotient	37	—.088
Thigh Flexor Strength	28	—.111
Burpee Test	25	—.113
Brace Test	24	—.118
Johnson Test	16	—.234

Throwing a Soccerball with a loading of .340, indicate very well why factor D was identified as sensori-motor coordination. Each one requires fine coordination between sensory judgment and motor execution for good performance. Basketball tests do not appear to correlate as highly with this factor as do baseball and football, probably because of

the difference in the size of the ball and the relative speed and distance of the flight of the ball.

At the bottom of the list we have (1) Strength tests, (2) Burpee Test, (3) Brace Test, (4) Johnson Test, and numerous other tests which are quite obviously not greatly dependent upon sensory-motor coordination.

Multiple Correlations and Regression Equations.—One of the chief problems in validating tests is to establish a criterion. We believe that the common and group factors which emerge in Thurstone's method of analysis are valid criteria of unitary components and that the regression weightings for combinations which give high multiple correlations with these factors are satisfactory for giving accurate estimates of such criteria. This entire assumption is based upon Thurstone's statement that factor loadings after rotation are equivalent to zero-order correlations with the common factor.* This assumption has been repeatedly checked empirically by the author and has in every case been found to be in accordance with logical expectancy.

"General Strength" has in the past been measured by several types of tests. The Strength Index used in this study was obtained by Rogers' technique and is the most popular strength test in use today. The author in a recent publication proposed using a battery of resistance tests as a measure of general strength.[20] In the present study this same battery stands out as a worthy substitute for the Rogers' test. Strength Index with a factor loading of .958 is slightly better than Total Resistance Strength with a factor loading .950.

The multiple correlation of the separate items in the Strength Index (omitting lung capacity) with the strength factor is .965 and with the addition of Classification Index and Thigh Flexors the multiple correlation becomes .981. The proportional regression weightings for raw scores of these two combinations are as follows:

	Name of Test		*b*'s	*b*'s
Strength =	Chinning Strength	×	1.000	.459
plus	Dipping Strength	×	.433	.100
plus	Sum of Grips	×	.714	.418
plus	Back Lift	×	.204	.128
plus	Leg Lift	×	.199	.099
plus	Classification Index	×	...	.325
plus	Thigh Flexors	×	...	1.000
	R	=	.965	.981

The multiple correlation of the four resistance strengths with the strength factor is .960 and the addition of the Sum of the Grips raises this to .974. A short battery of Chinning Strength, Thigh Flexors, Pectoralis Major, and Classification Index, correlates .984 with the strength

* Personal communication. Thurstone has not published the mathematical proof in clear cut form.

factor. The proportional regression weightings for these combinations are as follows:

	Name of Test		*b*'s	*b*'s	*b*'s
Strength =	Pectoralis Major	×	.983	1.000	1.000
plus	Arm Flexors	×	1.000	.680	...
plus	Leg Extensors	×	.188	.364	...
plus	Thigh Flexors	×	.218	.406	.383
plus	Sum of Grips	×	...	.480	...
plus	Chinning Strength	×	...	...	.350
plus	Classification Index	×	...	...	.181
	R	=	.960	.974	.984

The measurement of *"velocity,"* or *speed of movement,* has been a major factor studied in relation to motor ability. Conversely we may say that, in addition to strength, "velocity" is the chief factor governing physical performance. The two tests which appear at the top of the list in Table V, namely the Motor Quotient and the Brace Test, undoubtedly were validated against criteria which were primarily measures of velocity. They were proposed as tests of motor ability and educability and were believed to involve big-muscle coordination, strength, and speed of movement almost equally.

For predicting "velocity" we present the following combination which when weighted as indicated, correlates .838 with the "velocity" factor.

			b's
"Velocity" =	Motor Quotient	×	.188
plus	Physical Fitness Index	×	.097
plus	Potato Race	×	1.000
	R	=	.838

The Brace Test and Sargent Jump are omitted from this combination because they are a part of the Motor Quotient.

"Motor educability" has become a valuable concept for the better understanding of physical performance. The Brace Test was the first test to be proposed as a measure of "motor educability." In this study the Brace test appears to be chiefly a test of "velocity." The Johnson Test on the other hand seems to be primarily a test of motor educability. Its factor loading of .612 brands it as a profitable addition to any combination one might set up. The high loading .758 between Total Basketball and "motor educability" indicates the part this factor plays in governing the acquisition of basketball skills. We propose the following batteries for estimating "motor educability."

	Name of Test		*b*'s	*b*'s
Motor Educability =	Total Basketball	×	.176	...
plus	Johnson Test	×	.298	.195
plus	Burpee Test	×	—1.000	1.000
plus	Brace Test	×	—.532	—.120
	R	=	.821	.663

The three basketball tests are not included separately in order to simplify the above combinations. The second of these two combinations is the only one practicable for prediction in groups not homogeneously trained in basketball.

The *"sensori-motor coordination"* factor appears to be a group factor highly specific to sport skills especially of the baseball group. It would be unwise to attempt to set up a battery of these tests for predictive purposes partly because they lack objectivity and are too difficult to administer, but mainly because they are dependent upon previous experience and hence are not good test elements for the prediction of potential skills.

CONCLUSIONS

Evidence presented in this report indicates the presence of four underlying common factors in test performance in the field of physical education. These factors have been identified as: (1) strength, (2) velocity or speed of movement, (3) motor educability, and (4) sensori-motor coordination.

The identification of the strength factor was quite definite. The findings should point the way toward simpler and more efficient strength testing in the future. Combinations were set up and regression weightings were computed to provide high multiple correlations with the strength factor.

The velocity factor was also well identified, the data harmonizing with the results of other investigations. The high correlation between this factor and such items as Motor Quotient, the Brace Test, and Physical Fitness Index, have important implications as regards the nature of the velocity factor and its operation in motor performance. The combination of Motor Quotient, Physical Fitness Index, and the Potato Race, provides a fairly reliable "velocity" score. Quite naturally the degree of accuracy in predicting "velocity" does not compare with that of strength batteries because none of the variables are as specific. Indications are that further research is needed to validate simpler and more reliable tests of "velocity."

The motor educability factor was also quite easily identified. Such items as tests of basketball skills (dribbling, shooting, and passing) and the Johnson Test, proved to be most highly correlated with this factor. A combination of Johnson Test, Burpee Test, and the Brace Test, when ideally weighted provides a score which correlates quite well with the motor educability factor.

The last identifiable common factor was tentatively called sensori-motor coordination. Tests of throwing, catching, and fielding a baseball correlated most highly with this factor. No combinations to measure this component were set up because the tests with high correlations are too

difficult to administer. These results indicate that further research designed to validate more specific items for measuring these last three factors is needed. This, the author believes will in turn open up new approaches to the problems of tests and measurements in physical education.

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A Study of First-Aid Procedures Followed by Certain Secondary Schools in Detroit and in Michigan

(Preliminary Report)
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THE PROBLEM

THE problem in this study is to determine what procedures are being followed by secondary school students in administering first aid for the more common accidents and injuries.

The study grew originally out of a request made by the Lincoln Consolidated School for instructional material in first aid. This request was made to the Joint Health Committee of the State of Michigan. This committee appointed a sub-committee, of which the writer was made chairman, to study the problem and report to the Joint Committee.

THE PURPOSE OF THE STUDY

The purpose of the study is to determine the adequacy of first-aid treatment by junior and senior high school students according to sex, age, and grade in schools representing both urban and rural situations. It was anticipated that enough data could be secured to guide us intelligently in developing instructional material. Furthermore it was anticipated that we would have sufficient information as to where such instruction might best be given and as to what phases of the instruction needed the most emphasis.

It is recognized that the results of this study should not be the sole criterion upon which a course of study in first aid should be constructed, but it is expected that knowledge of conditions as they actually exist will play a large part in an intelligent approach to such a course. The opinion of experts, present courses in the field, and textbooks should be used to supplement the conclusions herein reached.

DATA AND METHOD USED

The following questionnaire was developed and results tabulated and classified with the aid of the research department of the Detroit Board of Education. Questionnaires were sent to twelve Detroit schools and

six out-state schools: Detroit—Cleveland, Durfee, Foch, Garfield, and Tappan Intermediate, Mackenzie, Cooley, Northeastern, Northern, Northwestern, Pershing, and Southwestern High Schools; Out-State—Beaverton, Kalamazoo Central, Chelsea, Chesaning, Kellogg, and Lincoln Consolidated.

THE QUESTIONNAIRE

Instructions to Teachers.—Have the pupils read the instructions. When all have finished, give an illustration of how the blank should be used. A personal experience of the teacher could be used effectively, or a plausible hypothetical case may be employed. For example, the teacher may say, "If you check *sprain* in the list of accidents you should write on the back of the page, under section XIV, exactly what you did to relieve the condition. If it were a sprained ankle you might say (1) bathed ankle in hot water, (2) wrapped tightly with strips of bandage, (3) didn't bear any weight on foot."

Stress (1) the time, *six months,* for the first three questions; (2) the time, *the pupil's entire life,* for the other questions; and (3) the necessity for description of just what was done on the reverse side.

Give all pupils ample time to finish.

MY EXPERIENCE WITH FIRST AID

Name..... School.....
Age..... Grade..... Sex.....

Explanation—In order to find out what type of training in first aid boys and girls need, the questions below are being asked of several thousand young people in high and intermediate schools in Michigan. This information will be very valuable if care is taken in answering the questions.

Since the first three questions deal with smaller accidents, to answer them you are asked to go back only *six months,* a period which covers both winter and summer. For the other questions which deal with much more serious accidents, you are to answer on the basis of *all of your life.*

If there are any accidents not listed *for which you have given first aid,* be sure to write them in after "Others" under one of the headings or under "Miscellaneous." On the back of the sheet, explain just what you did when you gave first aid. (If you have given aid more than once describe each time separately.)

	Yes	No
I. Have you given first aid *during the last six months* to either yourself or someone else?	...	...
II. Have you had any need to use first aid *during the last six months* but kept from doing so because you were not sure that you knew how?	...	...
III. If you have given any first aid *in the last six months,* check the accidents for which you have given this help.		
Bites: 1....Animal; 2....Insect; 3....Snake; 4....Other.....		
Bones and muscles: 5....Bone out of place; 6....Sprain; 7....Other.....		
Skin: 8....Bruise; 9....Burn; 10....Cut; 11....Pin Prick; 12....Other.....		
Removal of: 13....Slivers from any part of body; 14....Something from air passages; 15....Something from eye; 16....Other.....		
Miscellaneous: 17....Fainting; 18....Nosebleed; 19....Other.....		
IV. Have you *ever* revived or tried to revive anyone after drowning?	...	...
V. After electric shock?	...	...
VI. After monoxide (auto exhaust) poisoning?	...	...
VII. Have you *ever* stopped or tried to stop bleeding by use of a tourniquet?	...	...

	Yes	No
VIII. Have you *ever* given first aid to a person who has been poisoned (accidentally or intentionally)?	...	...
IX. Have you *ever* given first aid to a person who had received a serious blow to the head?	...	...
X. Have you *ever* given first aid for a broken arm, leg, finger, or other bone?	...	...
XI. Have any of the above injuries been caused by automobile accidents? If the answer is "yes," how many?.....	...	...

XII. Where have you received instruction in first aid?
1....Boy Scouts; 2....Campfire Girls; 3....Girl Scouts;
4....School; 5....Summer Camp; 6....Other.....

XIII. When did you receive instruction in first aid?
1....1936; 2....1935; 3....1934; 4....Before 1934; 5....Don't remember.

If you have checked anything, explain just what you did on the reverse of this sheet.

XIV. "My experience with first aid." Write below just what you did when you gave first aid. Tell of each case separately.

Write in Number (For example, if you have rendered first aid for electric shock write "V", the number of the question on the reverse side.)

....
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GENERAL PLAN OF TABULATION

The questionnaires were divided into five groups. These groups are not mutually exclusive, however, as may be observed below.

1. All Schools.
2. Out-State Schools.
3. All Detroit Intermediate and High Schools.
4. Detroit Intermediate Schools.
5. Detroit High Schools.

For each of the five general groups labeled 1 to 5, three sets of tabulations were made: (*a*) Totals for sex groups, (*b*) Grade groups by sex, (*c*) Age groups by sex.

Tabulations were also made of male and female totals for individual schools.

The ratings on adequacy of first-aid treatment administered were made by three senior and one junior medical students. A three-point scale was used on this rating. The steps were defined as:

1. Adequate—satisfactory treatment.
2. Inadequate—treatment probably of value but incomplete.
3. Poor—unsatisfactory and possibly harmful.

Many students who answered the questionnaire did not describe the treatment administered even though they checked some of the items which indicated they had administered first aid. Therefore, in some of the final tables, data on parts of this section of the questionnaire have been omitted because of the small number of cases involved.

All numbers appearing in the Tables are percentages with the exception of those in column 1 under "Adequacy of Treatment," pages 88–93.

STANDARDS EMPLOYED IN RATING TREATMENT "ADEQUATE"

Question — Treatment

III.

1. Animal Bites:
   a. Report animal to Police Department.
   b. Cleanse wound.
   c. Application of potent antiseptic (Iodine, Phenol, etc.)
2. Insect Bites:
   a. Apply soothing lotions.
3. Snake Bites:
   a. Cleanse and debride.
   b. Endeavor to determine whether snake is innocuous or not. If poisonous, see doctor immediately and apply tourniquet above bite.
5. Dislocations:
   a. Best not to manipulate.
   b. Splint to prevent further damage.
   c. Ice to reduce swelling.
6. Sprains:
   a. Ice to reduce swelling—later heat.
   b. Application of liniments.
   c. Tape snugly, but not too tightly.
   d. Rest part.
7. Bruises:
   a. Cleanse.
   b. Cold application to reduce swelling; heat for absorption.
   c. Mild antiseptics if continuity of skin is broken.
   d. May be covered with gauze.
8. Burns: (a) Mild:
   a. Cleanse.
   b. Application of soda
   c. or ointment.
   (b) Severe:
   a. Cleanse
   b. Application of soda.
   c. Application of tannic acid (5%) or
   d. If patient is in shock, treat shock first (see 14).
9. Cuts:
   a. Cleanse.
   b. Apply antiseptic.
   c. Bandage.
10. Pin prick:
   a. If pin is clean, apply mild antiseptic after cleansing.
   b. If pin is dirty or rusty, cleanse, apply antiseptics, and have Tetanus Antitoxin serum administered by doctor.
11. Removal of slivers:
   a. Cleanse.
   b. Remover by tweezers or needle which has been boiled.
   c. Application of antiseptic.
12. Removal of objects from air passages:
   a. Do not attempt to remove—call doctor.
   b. Put patient with head down.
13. Removal of objects from eye:
   a. If on lower lid, remove with toothpick upon which has been wrapped clean cotton, or corner of clean handkerchief.
   b. If in upper lid, evert the lid on match stick, and remove as above.

Question Treatment

c. Wash with Boric Acid solution.
d. Cover the eye with bandage.

14. Fainting:
a. Put patient in recumbent position with head at lower level than his legs.
b. Keep patient warm with blankets and give warm fluids.
c. Give patient Spirits of Ammonia for exhalation.

15. Nosebleed:
a. Place head back.
b. Cold applications to bridge of nose.
c. Pressure over bridge of nose.
d. Pack the nose.

IV. Resuscitation of drowned persons:
a. Keep patient warm.
b. Artificial respiration (Schaeffer, Sylvester method, etc.)

V. Resuscitation after electric shock:
a. Remove patient from contact—break circuit.
b. Artificial respiration.
c. Treat shock—keep warm, stimulants, etc.

VI. CO Poisoning:
a. Remove patient to open air.
b. Call Fire Department or other agency with respirator.

VII. Application of tourniquet:
a. Bleeding in hand and forearm, apply tourniquet above the elbow.
b. Bleeding in leg and foot, apply tourniquet above the knee.

VIII. Poisonings:
a. Endeavor to induce vomiting
1. By sticking finger down throat
2. By giving starch water.
b. To coagulate poison give milk or egg white.

IX. Head injuries:
a. In mild cases where apparently no symptoms, i.e., no loss of consciousness, etc.—leave alone, but observe for at least one day after for gradual development of symptoms. In any case of severe injury, even in absence of symptoms, consult physician.
b. Where symptoms develop as: loss of consciousness; severe headaches or dizziness; bleeding from ears, nose, etc., get medical treatment immediately. In meantime keep patient absolutely quiet in dark room, with head elevated.

X. Fractures:
a. Do not manipulate.
b. Put part at absolute rest; place in sling.
c. Transport patient to hospital.

XI. Automobile accidents:
Treatment depends on type of injury—see preceding.

STANDARDS EMPLOYED IN RATING TREATMENT "INADEQUATE"

Inadequate treatment consists of *incomplete good treatment* or over-treatment without marked bad results—combination of good and poor treatment, e.g., Animal bite—cleansed wound but neglected to keep it clean, etc.

STANDARDS EMPLOYED IN RATING TREATMENT "POOR"

Failure to include essential procedures suggested in good treatment plus additional remarks made below constitute *poor* treatment.

Question — Treatment

III.

1. Animal Bites:
   a. Neglecting to report animal.
   b. Failure to keep wound clean.
1. Insect Bites:
   a. Scratching or picking.
3. Snake Bites:
   a. Failure to cleanse wound.
   b. Overdoses of stimulant, e.g., whiskey.
5. Dislocations:
   a. Excessive manipulations.
6. Sprains:
   a. Application of Iodine only.
   b. Inadequate rest.
7. Bruises:
   a. Application of salves.
   b. Failure to cleanse dirt or oil from wound before applying antiseptic.
8. Burns:
   a. Butter, grease applications.
9. Cuts:
   a. Introduction of strong antiseptics into depths of wounds.
   b. Too tight bandaging.
10. Pin prick:
   a. Failure to apply antiseptic.
11. Removal of slivers:
   a. Probing with unclean implements.
12. Removal of objects from air passages:
   a. Attempts to remove objects.
13. Removal of objects from eye:
   a. Use of any unclean object for removing.
   b. Excessive rubbing of eye.
14. Fainting:
   a. Use of too forceful methods of reviving individual, viz, forceful slapping, or dousing with icewater.
   b. Internal medication in unconscious state.
18. Nosebleed:
   a. Failure to place head back.
   b. Failure to use cold compresses.
   c. Failure to pack nose.

IV. Resuscitation of drowned persons:
   a. Crowding about drowned person.
   b. Improper methods of artificial respiration.

V. Resuscitation after electric shock:
   a. Failure to break circuit properly.

VI. CO Poisoning:
   a. Failure to place patient in open air.
   b. Failure to call agency with respirator.

VII. Application of tourniquet.
   a. Failure to distinguish between arterial and venous bleeding.
   b. Improper placing of tourniquet (location).
   c. Improper application (too tight, too loose, too long).
   d. Inadequate time of, or excessive duration of use of, tourniquet.

VIII. Poisonings:
   a. Use of wrong neutralizing agents.

Question	Treatment
IX. Head injuries:	
a. Excessive manipulations; frequent moving of patient, etc.	
X. Fractures:	
a. Excessive manipulations.	
b. Transporting patient without protecting part from further injury by putting in sling.	
XI. Automobile accidents:	
a. These include many of the above noted accidents.	

THE INVESTIGATION

One hundred ninety-one tables have been compiled. It is not the purpose of this preliminary report to attempt an evaluation of all of these. Such investigations may probably best be left to the individual schools. To attempt to include analyses of each school by totals, sexes, grades and ages would make this report too long and too cumbersome to be understood easily.

In place of such a report which may better wait until a later date we have analyzed the questionnaires under the following classifications:

School	Sex	Grade	Age	No. of Cases
1. All	M. & F.	All	All	5,180
2. All	M.	All	All	2,479
3. All	F.	All	All	2,701
4. All Out-state	M. & F.	All	All	2,273
5. All Intermediate and High Detroit	M. & F.	All	All	2,907
6. All	M. & F.	8	All	1,248
7. All	M. & F.	10	All	1,979
8. All	M. & F.	12	All	1,078
All	M. & F.	All	13	651
All	M. & F.	All	15	1,338
All	M. & F.	All	18	277

GENERAL CONCLUSIONS

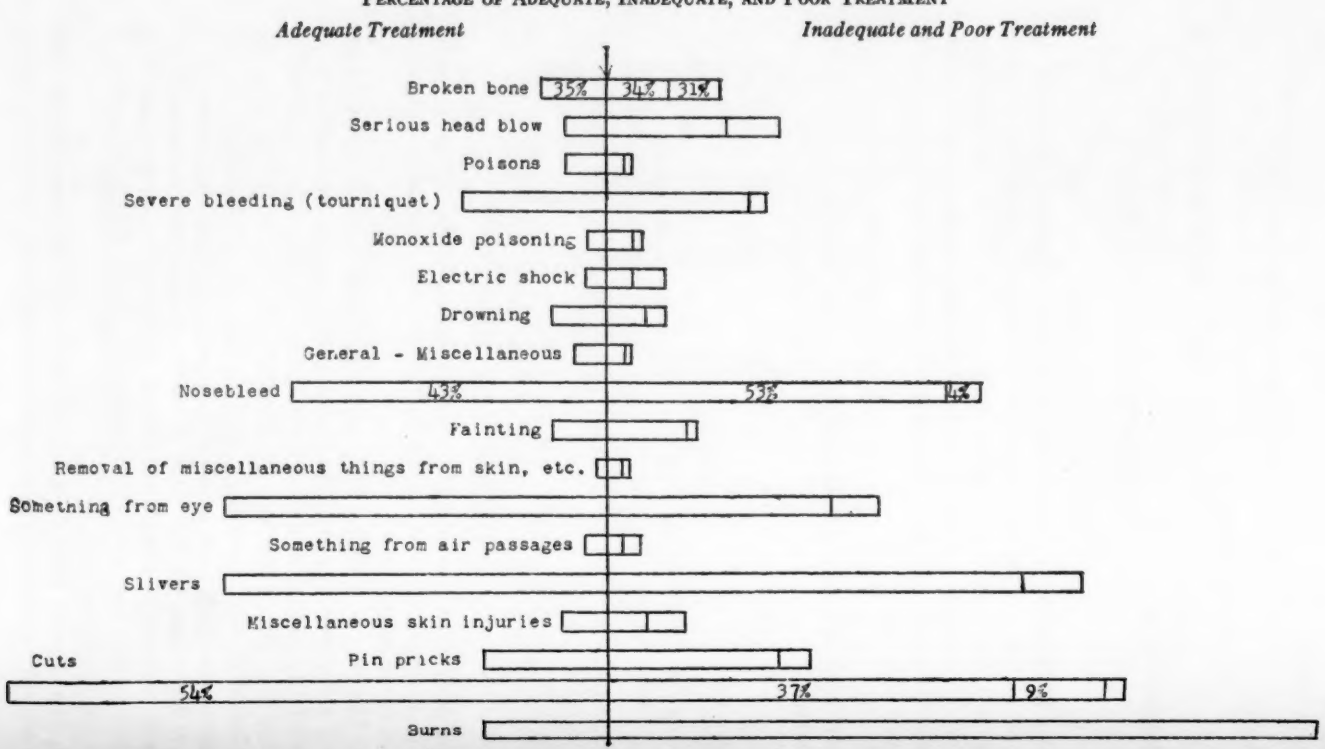
An analysis of the tables, (pages 88–93) individually, collectively, and by comparison would seem to indicate the following significant factors in the study.

1. The data on Group I (all cases) show that approximately 60 per cent of 5,180 students from the eighth grade through the twelfth in 18 schools fairly representative of Detroit and Michigan had occasion to practice first aid during the six months' period prior to the time the questionnaires were answered. Only 11 per cent of the total number refrained from using their knowledge, whether such knowledge was good, bad, or indifferent. In the light of the inadequate and poor treatment given as indicated further on in Table I it would seem apparent that children in this age group are anxious to do something regardless of what that something may be.

2. In analyzing these data further and comparing Item III with the data secured on the adequacy of first-aid treatment administered, we

CHART FOR GROUP I (All Cases)

PERCENTAGE OF ADEQUATE, INADEQUATE, AND POOR TREATMENT



Explanation: Each bar represents per cent of total of 5,180 students who administered first aid, e.g., the top bar represents 7 per cent of 5,180 who gave first aid for a broken bone, 35 per cent adequate treatment, 34 per cent inadequate, and 31 per cent poor.

find that out of 9,177 responses 41 per cent of that number gave what senior medical students from Wayne University, College of Medicine and Surgery, considered adequate, 47 per cent inadequate, and 12 per cent poor or possibly harmful. As stated before, no attempt is being made in this preliminary report to analyze in detail all the 29 accidents under Item III. It is of interest, however, to note the adequacy of treatment for some of the more common accidents. For example Item III-9 refers to burns. Thirty-five per cent of 5,180 students had occasion to treat burns. Of this 35 per cent (1,214), only 13 per cent rendered adequate treatment. 61 per cent did something that gave some relief but was inadequate, while 26 per cent rendered poor or possibly harmful treatment.

Item III-10 referring to cuts embraced the largest number of treatments, 48 per cent, as would naturally be expected. Of the total number of 1,779 who stated what first aid was administered, 54 per cent or slightly more than half rendered satisfactory treatment, 37 per cent were inadequate, and 9 per cent were poor or harmful.

One might expect a higher percentage of adequate treatment for removal or care of splinters but these percentages: 42 per cent adequate, 51 per cent inadequate, and 7 per cent poor, are not particularly encouraging.

Animal bites, snake bites, bones out of place, something in the air passages, and electric shock are of course not particularly common accidents but the results of poor or harmful treatment render them important. Percentages of poor treatment were relatively high with these, 36 per cent, 36 per cent, 54 per cent, 35 per cent and 47 per cent, respectively. The lowest percentage of adequate treatment for any single accident was in caring for a bone out of place, only 12 per cent doing this correctly. The highest percentage of adequate treatment occurred in removing a foreign particle from the eye, 62 per cent being adequate, 32 per cent inadequate and only 6 per cent poor.

3. A total of 9,177 responses were made explaining first aid administered. Forty-one per cent were adequate, 47 per cent inadequate, and 12 per cent poor. These findings alone would lead us to believe that our instruction is either insufficient or fallacious or both.

4. The figures for Group I are of further interest in that they supply us with information as to where instruction has been received. The fact that only 35 per cent indicated that their instruction had been received in school is significant. Others received instruction from scattered sources, such as, Boy Scouts 15 per cent, Campfire Girls 3 per cent, Girl Scouts 11 per cent, summer camp 11 per cent, miscellaneous 18 per cent. The percentage receiving instruction in school is significant in the light of the fact that 59 per cent had rendered first aid whereas a total of only 35 per cent have been reached in school. When comparisons are made

Explanation: Each bar represents per cent of total of 5,180 students who administered first aid, e.g., the top bar represents 7 per cent of 5,180 who gave first aid for a broken bone, 35 per cent adequate treatment, 34 per cent inadequate, and 31 per cent poor.

later with the type of aid rendered and the place where instruction was given further significance can be attached to these percentages.

5. The data secured for Group I, Item XIII, which asks when instruction was given, are of doubtful value although the fact that a total of 41 per cent stated that they had either received instruction before 1934 or didn't remember when may have some bearing upon the inadequacy of treatment in view of constantly changing methods being employed in rendering first aid. This is particularly true in the case of the treatment of burns and cuts.

6. Groups II and III, showing replies by sexes, have striking similarities in most of the items. Percentages run very close in the accidents treated and also in the type of aid rendered. As might be expected, cuts and bruises run higher in treatment rendered among boys than among girls. Girls had slightly more occasion to render first aid for fainting than boys. Boys had slightly more occasion to treat for nosebleed. On the whole there was little variation.

7. The most interesting comparisons between these two tables are in the percentages of adequate, inadequate, and poor treatment. Girls were consistently better in *every one* of the 26 accidents listed.

The totals show nearly the same number of responses for each sex, boys 4,276, girls 4,911. Girls' treatments were adequate in 40 per cent of the cases as compared to 36 per cent for the boys. Girls were inadequate in 45 per cent to the boys' 50 per cent. Poor or harmful treatment was rendered by the girls in 11 per cent of the cases to 14 per cent by the boys.

8. A comparison of Groups IV and V shows striking similarities in most items. Detroit showed a slightly higher percentage of students who gave first aid during the six months' period, 62 per cent as compared with 56 per cent, but accidents treated varied only 1 or 2 per cent through the whole list of 26 accidents.

Scarcely any variation is seen in where instruction was given, e.g., Detroit showed 34 per cent of the instruction in school and out-state schools show 37 per cent. Other percentages were even closer than this, e.g., Detroit Boy Scouts, 15 per cent; out-state Boy Scouts, 16 per cent.

Detroit shows a higher percentage of adequate treatments, however, 42 per cent as compared with 29 per cent. Forty-one per cent of the treatment in Detroit was inadequate as compared to 52 per cent out-state. Poor treatment was about the same, 17 per cent in Detroit and 19 per cent out-state.

9. Groups VI, VII, and VIII (grades 8, 10, and 12 respectively) yield the following significant data.

Item I shows that 70 per cent of the eighth graders rendered first aid, 53 per cent in the tenth grade and 59 per cent in the twelfth grade.

Again the accidents treated vary but slightly in all these grades, for

example cuts, the most common, show 57 per cent in the eighth grade, 43 per cent in both the tenth and twelfth.

The most significant factor in these tables, however, is that even though 70 per cent of the eighth graders rendered first aid as compared to 53 per cent in the tenth and 59 per cent in the twelfth, only 23 per cent of the treatment given in the eighth grade was adequate as compared to 46 per cent and 52 per cent adequate treatment in the tenth and twelfth. These figures alone might lead one to believe that much more instruction should be given at the eighth grade level or below.

10. A comparison of Groups IX, X, and XI, as would be expected, shows quite similar data to the grade tables. 70 per cent of those 13 years of age had occasion to render first aid, 53 per cent of those 15 years old, and 57 per cent of those 18 years old. Again there is a decided lack of adequate treatment at the lower age level. The 13-year-olds showed 23 per cent adequate, the 15-year-olds 40 per cent, and the 18-year-olds 49 per cent.

The frequency of rendering first aid in the 13-year old group as well as in the eighth grade group may be accounted for by the fact that children of this age are naturally more prone to suffer minor accidents than those in the older age groups. They are perhaps too old to run home to mother and therefore attempt some sort of first aid for themselves or their playmate. Whatever may be the reason on the basis of the conditions as shown to exist, one definite recommendation could be made, namely, that first aid instruction start on a lower age level than it seemingly does at present.

GROUP I—ALL CASES

Item	Per cent			Adequacy of Treatment		
	Yes	No	Omit	No.	A.	I.
I. Have you given first aid during the last six months either to yourself or someone else?	59	40	1			
II. Have you had any need to use first aid during the last six months but kept from doing so because you were not sure that you knew how?	11	87	2			
III. If you have given any first aid *in the last six months*, check the accidents for which you have given this help.						
Bites:						
1. Animal	5		95	165	16	48
2. Insect	11		89	344	58	34
3. Snake	1		99	39	33	31
4. Other	2		98	19	57	32
Bones and Muscles:						
5. Bone out of place	4		96	80	18	28
6. Sprain	17		83	585	40	54
7. Other	2		98	46	46	41
Skin:						
8. Bruise	18		82	476	29	63
9. Burn	35		65	1,214	13	61
10. Cut	48		52	1,779	54	37
11. Pin prick	13		78	282	36	56
12. Other	4		96	76	32	36
Removal of:						
13. Slivers from any part of the body	35		65	1,123	42	51
14. Something from air passages	2		98	43	39	26
15. Something from eye	30		70	842	62	32
16. Other	1		99	22	32	41
Miscellaneous:						
17. Fainting	6		94	203	33	58
18. Nosebleed	28		72	917	43	53
19. Other	2		98	25	44	40
IV. Have you *ever* revived or tried to revive anyone after drowning?	5	92	3	90	42	39
V. After electric shock?	3	95	2	17	12	41
VI. After monoxide (auto exhaust) poisoning?	2	96	2	12	25	67
VII. Have you *ever* stopped or tried to stop bleeding by use of a tourniquet?	12	86	2	290	45	49
VIII. Have you ever given first aid to a person who has been poisoned (accidentally or intentionally)?	3	93	4	56	54	41
IX. Have you *ever* given first aid to a person who had received a serious blow to the head?	9	88	3	288	20	56
X. Have you *ever* given first aid for a broken arm, leg, finger, or other bone?	7	91	2	144	35	34
XI. Have any of the above injuries been caused by automobile accidents? If the answer is "yes" how many?	5	90	5			
XII. Where have you received instruction in first aid?						
1. Boy Scouts	15		85			
2. Campfire Girls	3		97			
3. Girl Scouts	11		89			
4. School	35		65			
5. Summer Camp	11		89			
6. Other	18		82			
XIII. When did you receive instruction in first aid?						
1. 1936	20		80			
2. 1935	20		80			
3. 1934	16		84			
4. Before 1934	21		79			
5. Don't remember	20		80			

Item	Group II—All Males							Group III—All Females						
	Per cent			Adequacy of Treatment				Per cent			Adequacy of Treatment			
	Yes	No	Omit	No.	A.	I.	P.	Yes	No	Omit	No.	A.	I.	P.
I.	63	37	0					57	42	1				
II.	12	87	1					10	88	2				
III.														
1.	8		92	98	12	49	39	3		97	67	22	47	31
2.	12		88	158	52	36	12	10		90	186	62	33	5
3.	2		98	30	33	33	34	0		100	9			
4.	4		96	9				1		99	10	50	30	20
5.	6		94	55	13	20	67	2		98	25	32	44	24
6.	21		79	306	35	58	7	13		87	279	46	50	4
7.	3		97	23	39	48	13	1		99	23	52	35	13
8.	23		77	240	25	67	8	14		86	236	35	58	7
9.	33		67	469	10	66	24	36		64	745	14	59	27
10.	53		47	857	51	40	9	43		57	922	57	34	9
11.	10		90	87	34	59	7	16		84	195	37	54	8
12.	4		96	37	24	44	32	3		97	39	38	31	31
13.	38		62	497	35	55	10	33		67	626	48	47	5
14.	3		97	30	23	47	30	2		98	23	44	30	26
15.	30		70	337	60	33	7	29		70	505	65	31	4
16.	2		98	12	25	25	50	1		99	10	40	60	0
17.	5		95	62	31	59	10	7		93	141	35	56	9
18.	30		70	397	40	54	6	26		74	520	45	52	3
19.	2		98	6				1		99	19	47	32	21
IV.	6	93	1	65	47	38	15	3	92	5	25	28	40	32
V.	3	95	2	12	17	42	41	3	95	2	5			
VI.	3	95	2	9				1	97	2	3			
VII.	17	81	2	190	40	54	6	7	91	2	100	55	39	6
VIII.	4	93	3	29	52	41	7	2	92	6	27	55	41	4
IX.	12	85	3	170	16	59	25	6	89	5	118	27	51	22
X.	9	89	2	92	33	37	30	4	94	2	53	40	30	30
XI.	6	89	5					3	90	7				
XII.														
1.	31		69					1		99				
2.	2		98					3		97				
3.	3		97					18		82				
4.	32		68					38		62				
5.	12		88					10		90				
6.	16		84					20		80				
XIII.														
1.	23		77					18		82				
2.	23		77					17		83				
3.	19		81					14		86				
4.	21		79					21		79				
5.	18		82					21		79				

Item	Group IV—Out-State Cases, Male-Female: Per cent Yes	No	Omit	Adequacy of Treatment: No.	Per cent A.	I.	P.	Group V—Detroit Cases, M and F: Per cent Yes	No	Omit	Adequacy of Treatment: No.	Per cent A.	I.	P.
I.	56	43	1					62	37	1				
II.	10	89	1					12	86	2				
III.														
1.	5		95	61	7	47	46	5		95	104	22	48	30
2.	11		89	119	50	44	6	11		89	225	62	29	9
3.	0		100					1		99	30	37	30	33
4.	2		98	12	50	42	8	3		97				
5.	4		96	31	10	30	60	3		97	49	24	27	49
6.	16		84	197	32	66	2	18		82	388	44	48	8
7.	3		97	18	45	44	11	2		98	28	47	39	14
8.	18		82	153	12	81	7	19		81	323	38	54	8
9.	36		64	438	14	59	27	34		66	776	12	63	25
10.	47		53	591	40	43	17	48		52	1,188	60	34	6
11.	14		86	86	28	62	10	12		88	196	40	53	7
12.	3		97	24	12	59	29	4		96	52	40	27	33
13.	36		64	401	38	54	8	35		65	722	44	49	7
14.	2		98					3		97	35	43	26	31
15.	31		69	282	51	43	6	29		71	560	68	27	5
16.	1		99					1		99	17	24	47	29
17.	6		94	68	22	68	10	6		94	135	39	52	9
18.	29		71	333	37	61	2	27		73	584	47	48	5
19.	2		98	11	46	36	18	2		98	14	43	43	14
IV.	4	95	1	18	6	61	33	5	90	5	72	50	33	17
V.	3	95	2					3	94	3				
VI.	1	97	2					2	96	2				
VII.	14	84	2	121	27	66	7	11	87	2	169	58	37	5
VIII.	2	95	3	23	48	39	13	3	92	5	33	58	42	
IX.	8	90	2	111	14	56	30	10	87	3	177	25	55	20
X.	6	92	2	57	26	39	35	7	91	2	87	41	31	28
XI.	6	87	7					4	91	5				
XII.														
1.	16		84					15		85				
2.	2		98					3		97				
3.	13		87					9		91				
4.	37		63					34		66				
5.	11		89					12		88				
6.	17		83					19		81				
XIII.														
1.	19		81					21		79				
2.	18		82					21		79				
3.	18		82					15		85				
4.	26		74					17		83				
5.	18		82					21		79				

Item	Group VI—All Cases of Grade 8								Group VII—All Cases of Grade 10							
	Per cent			Adequacy of Treatment					Per cent			Adequacy of Treatment				
	Yes	No	Omit	No.	A.	I.	P.	Per cent	Yes	No	Omit	No.	A.	I.	P.	Per cent
I.	70	29	1						53	46	1					
II.	16	83	1						10	89	1					
III.																
1.	6		94	70	11	44	45		5		95	45	27	55	18	
2.	17		83	158	56	33	11		7		93	88	58	36	6	
3.			99	16	6	44	50		1		99					
4.	2		98						2		98					
5.	3		97	21	5	14	81		3		97	24	33	46	21	
6.	19		81	200	21	68	11		14		86	181	54	43	3	
7.	2		98	19	32	47	21		2		98	10	60	30	10	
8.	23		77	200	14	75	11		17		83	155	48	49	3	
9.	40		60	425	6	48	46		31		69	392	14	76	10	
10.	57		43	670	43	49	8		43		57	593	65	28	7	
11.	15		85	117	15	76	9		10		90	105	57	39	4	
12.	5		95	31	26	26	48		3		97	21	33	48	19	
13.	39		61	381	31	56	13		34		66	406	58	39	3	
14.	3		97	22	32	32	36		1		99					
15.	33		67	295	58	35	7		25		75	255	68	30	2	
16.	1		99						1		99					
17.	5		95	61	21	64	15		6		94	77	35	60	5	
18.	31		69	299	34	59	7		25		75	113	43	55	2	
19.	1		99						1		99					
IV.	3	88	9	21	14	43	43		4	95	1	27	30	66	4	
V.	3	94	3						4	94	2					
VI.	3	95	2						3	95	2					
VII.	11	86	3	68	21	69	10		12	86	2	92	54	39	7	
VIII.	4	89	7	11	18	82	0		2	94	4	17	70	18	12	
IX.	9	85	6	80	6	58	36		9	89	2	98	33	51	16	
X.	7	91	2	35	17	49	34		6	91	3	46	43	35	22	
XI.	4	93	3						4	90	6					
XII.																
1.	12		88						16		84					
2.	4		96						2		98					
3.	8		92						11		89					
4.	30		70						36		64					
5.	13		87						9		91					
6.	24		76						14		86					
XIII.																
1.	26		74						19		81					
2.	19		81						22		78					
3.	13		87						16		84					
4.	10		90						17		83					
5.	24		76						18		82					

Item	Group VIII—All Cases of Grade 12							Group IX—All Cases of Age 13						
	Per cent			Adequacy of Treatment				Per cent			Adequacy of Treatment			
	Yes	No	Omit	No.	A.	I.	P.	Yes	No	Omit	No.	A.	I.	P.
I.	59	40	1					70	29	1				
II.	9	89	2					15	84	1				
III.														
1.	3		97	23	30	44	26	6		94	36	6	63	31
2.	8		92	40	73	22	5	21		79	112	55	33	11
3.	2		98	10	80	10	10	1		99	11	9	45	46
4.	2		98					3		97				
5.	5		95	21	19	24	57	2		98	12	8	0	92
6.	17		83	126	60	38	2	19		81	97	19	65	16
7.	3		97					2		98	13	31	54	15
8.	16		84	63	48	46	6	24		76	120	14	77	9
9.	33		67	223	20	64	16	42		58	232	6	52	42
10.	43		57	290	67	24	9	63		37	388	42	50	8
11.	7		93	27	60	33	7	17		83	70	11	76	13
12.	3		97	13	54	38	8	5		95	16	43	19	38
13.	32		68	187	44	52	4	42		58	221	34	54	12
14.	3		97					3		97				
15.	30		70	170	68	26	6	36		64	183	54	40	6
16.	2		98	10	20	50	30	1		99				
17.	7		93	38	56	39	5	6		94	34	24	61	15
18.	25		75	173	62	33	5	33		67	162	33	60	7
19.	3		97	11	46	27	27	1		99				
IV.	6	92	2	36	72	14	14	3	96	1				
V.	1	97	2					1	97	2				
VI.	1	96	3					1	98	1				
VII.	13	85	2	80	68	31	1	8	90	2	40	18	77	5
VIII.	2	95	3	20	65	35	0	4	94	2				
IX.	8	89	3	62	26	59	15	6	91	3	42	2	46	52
X.	7	90	3	44	52	16	32	5	93	2	14	7	65	28
XI.	4	86	10					3	95	2				
XII.														
1.	17		83					12		88				
2.	3		97					2		98				
3.	13		87					9		91				
4.	34		66					29		71				
5.	14		86					15		85				
6.	18		82					21		79				
XIII.														
1.	14		86					32		68				
2.	14		86					20		80				
3.	17		83					12		88				
4.	36		64					10		90				
5.	19		81					21		79				

Item	Group X—All Cases of Age 15							Group XI—All Cases of Age 18						
	Per cent			Adequacy of Treatment Per cent				Per cent			Adequacy of Treatment Per cent			
	Yes	No	Omit	No.	A.	I.	P.	Yes	No	Omit	No.	A.	I.	P.
I.	53	46	1					57	43	0				
II.	9	89	2					8	80	12				
III.														
1.	5		95	27	30	51	19	3		97				
2.	7		93	60	47	48	5	4		96				
3.	1		99					0		100				
4.	2		98					2		98				
5.	3		97	20	30	40	30	6		94				
6.	14		86	134	52	46	2	18		82	30	54	43	3
7.	2		98					5		95				
8.	16		84	96	36	61	3	16		84	13	23	77	
9.	32		68	303	13	77	10	30		70	60	10	77	13
10.	41		59	390	57	32	11	42		58	70	53	33	14
11.	11		89	68	54	40	6	6		94				
12.	4		96	17	41	47	12	2		98				
13.	34		66	275	57	41	2	35		65	50	42	52	6
14.	2		98					1		99				
15.	26		74	188	61	35	4	30		70	50	78	18	4
16.	1		99					0		100				
17.	6		94	56	34	61	5	6		94				
18.	28		72	234	39	58	3	21		79	40	68	30	2
19.	2		98					3		97				
IV.	4	94	2	17	18	58	24	8	90	2	27	77	19	4
V.	5	93	2					0	97	3				
VI.	1	97	2					1	95	4				
VII.	12	86	2	78	38	56	6	15	83	2	24	67	33	
VIII.	2	93	5	12	42	41	17	4	93	3				
IX.	9	89	2	62	42	37	21	10	87	3	12	17	83	
X.	5	93	2	36	36	42	22	9	88	3	14	57		43
XI.	5	89	6					3	92	5				
XII.														
1.	16		84					23		77				
2.	2		98					1		99				
3.	12		88					8		92				
4.	37		63					31		69				
5.	9		91					8		92				
6.	15		85					17		83				
XIII.														
1.	19		81					14		86				
2.	21		79					15		85				
3.	17		83					15		85				
4.	18		82					30		70				
5.	21		79					20		80				

A Comparison of the Academic Grades and Intelligence Scores of Participants and Nonparticipants in Intramural Athletics at the University of Kentucky

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PURPOSE OF STUDY

INTRAMURAL athletics have become a vital factor in the student's educational life in our schools today and offer an excellent medium through which many educational objectives may be reached. The college student generally finds competition in intramural athletics a source of wholesome recreation through which he may test his skill in activities already learned through the physical education curriculum. Many desirable habits and attitudes are learned by the student through properly supervised intramural competition which could not otherwise be taught. So important have intramural athletics become in our educational system that there has been talk of substituting them for intercollegiate and interscholastic competition. Such a step is of questionable value, but the suggestion indicates the growing importance of such an activity.

Interest in intramural athletics has been on the increase in the past ten years in all sections of our country and on all school levels. In a recent study made by E. T. Johnson on the status of intramural athletics in southern universities and colleges, it was found that of a total male enrollment of 40,000, approximately 28,000 or 70 per cent of the male student body participated in intramural athletics.[1] With the increase in participation there have also been increases in competitive units, types of sports, facilities, emphasis on the physical education curriculum, and many other phases connected directly or indirectly with intramural athletics.

A problem which has arisen in connection with intramural participation in the college and university level is the matter of permitting first-year men to compete. Some educational authorities state that fresh-

[1] E. T. Johnson, "Report on the Status of Intramurals in Universities and Colleges of the South." Thesis, 1937, University of Kentucky.

men should spend more time on their academic work and less on extracurricular activities. Many organizations with a zeal to accumulate participation points force freshmen pledges or members into intramural sports without regard to the time they may or may not have to devote to these activities. Quite frequently upper classmen urge freshmen into the more strenuous activities in which they themselves do not care to participate. E. D. Mitchell states "that this tendency, if abused, may mean that certain freshmen during this critical period of adjustment to college life may take part in too many athletic activities and fail in their subjects."[2]

There are, however, some educators who champion the idea of intramural participation for first-year college men and support their views on two bases, namely, that interest in intramural participation for the following years must be aroused during the freshman year, and that the first-year men have fewer campus activities than the upper classmen, and it is very essential that they should be provided with the proper recreation.

It is the purpose of this investigation not only to study the relation of intramural participation to freshmen academic grades but also to the academic standing of sophomore, junior, and senior university students.

METHOD OF INVESTIGATION

The data for this investigation were obtained from the academic records at the Office of the Registrar, the intelligence test records of the Department of Psychology, and the intramural participation record of the 1935–36 school year of the Intramural Division of the Department of Physical Education, University of Kentucky.

The average academic standings and intelligence test scores of 322 students were used in this study. These students were classified as participants or nonparticipants in intramural athletics and numbered 161 in each group.

In the above groups, participants and nonparticipants, an equal number of students was used in each class: 48 freshmen, 41 sophomores, 38 juniors, and 34 seniors. The students in the participant group were taken directly from the intramural records, including only those who engaged in team sports and who participated in more than three activities. The 161 participants in intramural athletics engaged in an average of six different activities including team sports. The students used in the nonparticipant group were secured by random sampling from the registrar's records.

The method employed by the University of Kentucky for computing grade letters into grade points was used in this study. The following table will explain the method.

[2] E. D. Mitchell, *Intramural Athletics*. (New York: A. S. Barnes and Co., 1925).

Grade	Credits	Point per credit	Grade point
A	3	3	9
B	3	2	6
C	3	1	3
D	3	0	0
E	3	0	0

The average grade of standing is computed by dividing the total number of credits into the total number of grade points. In this investigation the average grades or standings of participants and nonparticipants were determined for the school year 1935–36.

The mean average academic grade of the participants and nonparticipants in intramural athletics and the standard error of the means were calculated for the freshman, sophomore, junior, and senior groups.

The mean average of the intelligence test scores of the participants and nonparticipants in intramural athletics and the standard error of the means were determined for the freshman, sophomore, junior, and senior groups.

RESULTS

Tables I to IV give the results derived from computing the means, standard error of the means of the academic grades and intelligence test scores (sigma ranking), and other factors pertinent to the investigation.

TABLE I

MEAN ACADEMIC GRADE AND SIGMA RANKING* OF PARTICIPANTS AND NONPARTICIPANTS IN INTRAMURAL ATHLETICS

Class	Mean Academic Standing		Mean Sigma Ranking	
	Nonparticipants	Participants	Nonparticipants	Participants
Freshman	1.06	1.19	.035	.095
Sophomore	1.20	1.23	—.265	.120
Junior	1.11	1.33	.050	.110
Senior	1.27	1.52	.215	.465

* The scores of each year's intelligence tests at the University of Kentucky are placed in a sigma range of ±3 with zero as the mean average of the freshman class.

DISCUSSION

The average sigma ranking shown in Table I indicates that in all classes the participants in intramural athletics have a higher mean sigma ranking than the nonparticipants. The nonparticipants in the sophomore group indicate a minus sigma mean average yet almost equal the mean academic grade of the participants in intramural athletics. Both nonparticipants and participants in all classes except the sophomore nonparticipants have a sigma mean average above the University of Kentucky average for all students.

The mean academic grade of the participants, according to Table I, in all classes is greater than that of the nonparticipants in intramural athletics. One might question the results of the freshman groups since Table II indicates that there are eleven engineers listed among the nonparticipants while the participant group contains only two freshmen from that field. In this case, however, the eleven freshmen engineers did not influence the mean academic grade of the class as much as might be expected since their average as a specific group was 1.09 or .03 better than the mean of the entire group of freshmen nonparticipants.

Table III shows a mean difference in academic grades in favor of the participants in intramural athletics. The mean differences in academic grades are .13, .03, .22, and .25 for the freshman, sophomore, junior, and senior classes respectively.

TABLE II

COLLEGE DISTRIBUTION OF PARTICIPANTS AND NONPARTICIPANTS

	A.S.	Ed.	Eng.	Com.	Ag.	Law
			Freshmen			
Nonparticipants	17	1	11	10	9	0
Participants	21	0	2	18	7	0
			Sophomores			
Nonparticipants	11	3	7	13	7	0
Participants	14	4	5	14	4	0
			Juniors			
Nonparticipants	13	1	9	8	2	5
Participants	13	0	7	9	7	2
			Seniors			
Nonparticipants	13	3	4	8	2	4
Participants	14	3	4	9	4	0
			Total			
Nonparticipants	54	8	31	39	20	9
Participants	62	7	18	50	22	2

From the mean difference in academic grades and the standard deviation of the mean, the standard error of the difference of mean grades was calculated. For the value of the standard error see Table III.

The question that now arises is whether the mean difference in the academic grades of the participants and the nonparticipants of each class is merely due to chance selection of the groups or whether the difference would be fairly certain to occur in any other similar group. This is determined by the value of the standard error.

When the mean difference over the standard error $\frac{D}{\sigma \text{ diff}}$ is equal to three, it is indicative of complete reliability since ± 3 sigma includes practically all the cases in the distribution differences below the mean. A quotient greater than three is taken as just so much added reliability.

Referring to Table III the mean difference over the standard error in the case of the freshmen equals 1.08. If this quotient was equal to 0,

TABLE III
STANDARD ERROR OF ACADEMIC GRADE

Class	Mean Grade		Standard Deviation		Number of Cases		Mean Diff.	Standard Error	D / σ (diff.)
	Nonparticipant	Participant	Nonparticipant	Participant	Nonparticipant	Participant			
Freshman	1.06	1.19	.552	.639	48	48	.13	.12	1.08
Sophomore	1.20	1.23	.537	.513	41	41	.03	.11	0.27
Junior	1.11	1.33	.507	.675	38	38	.22	.13	1.69
Senior	1.27	1.52	.495	.711	34	34	.25	.14	1.78

TABLE IV
STANDARD ERROR OF SIGMA RANKING

Class	Mean Sigma Ranking		Standard Deviation		Number of Cases*		Mean Diff.	Standard Error	D / σ (diff.)
	Nonparticipant	Participant	Nonparticipant	Participant	Nonparticipant	Participant			
Freshman	.035	.095	1.19	.985	46	44	.60	.22	2.72
Sophomore	—.265	.120	1.11	.855	38	38	.39	.22	1.77
Junior	.050	.110	0.96	.865	30	38	.06	.24	0.25
Senior	.215	.465	0.885	.975	29	28	.25	.24	1.04

* Some of the sigma standings were unavailable.

we should say that the chances were 50–50, or even that the participants would generally show better academic grades than the nonparticipants in intramural athletics or vice versa. But according to the normal probability tables a quotient of 1.08 indicates that the chances are 86 in 100 that the true difference is greater than zero,[8] or that the freshmen participant in intramurals will stand a greater chance of having better academic grades than the nonparticipants.

The value of the mean difference over the standard error in the case of the sophomores equals 0.27. This quotient cannot be considered reliable. But in the case of the juniors and seniors the obtained difference may be considered at least fairly reliable. The normal probability tables indicate that by quotients of 1.69 and 1.78 the junior and senior intramural participants stand 96 chances in 100 that the true difference is greater than zero.

The mean difference over the standard error, according to Table IV, equals 2.72 in favor of the freshmen participants in sigma ranking. A quotient of this proportion indicates almost complete reliability. The quotients of 1.77 and 1.04 for the sophomore and senior classes respectively in sigma ranking indicates a fair reliability, yet the quotient of 0.25 derived for the junior class cannot be considered very reliable since it is so small.

CONCLUSIONS

The results of the study suggest:

1. That freshman participation in intramural athletics does not have a marked effect upon the student's academic grade.

2. That párticipants in intramural athletics as a whole have a higher mean intelligence sigma ranking than those who do not participate.

3. That sophomore participants show a slightly higher mean academic grade and that junior and senior intramural participants demonstrate a definitely higher mean academic grade than do nonparticipants of the same classes.

[8] J. F. Bovard and F. W. Cozens, *Tests and Measurements in Physical Education.* (Philadelphia: W. B. Saunders Co., 1930.)

Student Housing Survey

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INADEQUATE housing conditions have a causal relation to increased morbidity and mortality rates, and the provision of adequate housing is becoming an important public health problem.[1,2]

In accordance with these generally accepted views of the relationship of adequate housing to the maintenance of health of the occupants, the National Conference on College Hygiene at its meeting held in Washington, D. C., December, 1936, expressed the opinion that the sanitary supervision of student housing is a desirable function of the college student health service in its attempt to preserve the health of the student body.[3] In September, 1936, the Faculty Council on Student Affairs of Kansas State College, through the initiative and cooperation of Mrs. Mary P. Van Zile, Dean of Women, and A. A. Holtz, Men's Adviser, gave to the Student Health Service the responsibility for the sanitary inspection of privately operated student rooming houses.

Kansas State College relies on four sources in providing living quarters for approximately 3500 students; (1) social organizations maintaining chapter houses, (2) a women's dormitory, (3) homes of students whose parents live in the local community, and (4) privately operated rooming houses. These privately operated rooming houses are provided by townspeople who operate them for the purpose of making a reasonable profit. The college regulations provide that no student may live in a rooming house that has not been inspected and approved by the college. The student rooming facilities offered by these rooming houses vary markedly, but are believed to be quite typical of the average college town. The population of Manhattan in which this college is located is approximately 11,000. About two-thirds of the total student population live in these privately operated rooming houses.

In 1936 and 1937 the Student Health Service made a survey of all privately operated student rooming houses. The results of the survey are summarized in Table 1.

Every room approved for possible student occupancy was inspected

1 Rollo H. Britten, "The Relation between Housing and Health," *Public Health Reports*, 49:44 (November 2, 1934), p. 1301.
2 C-E. A. Winslow, "Housing as a Public Health Problem," *Amer. Jr. Public Health*, 27:1 (Jan. 1937), p. 56.
3 *Proceedings of the Second National Conference on College Hygiene*, (New York: National Tuberculosis Association, 1937).

for ventilation, closet space, furniture, heat, light, and potential number of occupants per room. In addition to this individual room inspection the bathroom facilities and general cleanliness of the house were recorded. Basement rooms were investigated carefully for dampness. Based on the degree in which the housing factors just enumerated were adequately provided, each house was rated A, B, C, or Unsatisfactory. In general the following principles were considered in making the final ratings:

TABLE I

	Number	Per Cent
Rooms inspected	984	
Basement rooms inspected	48	4.8
Houses inspected	371	
Rating of Houses—		
No. A	204	55.0
No. B	130	35.0
No. C	33	8.9
No. U	4	1.1
Houses with eight or more persons per single toilet or lavatory	116	31.2
Houses with less than eight persons per single toilet or lavatory but shared with family	153	41.2

(A) A house in which each room has cross ventilation, adequate closet space, individual study tables, furnace heat, sixty-watt ceiling lights with provision for study lamps, less than eight persons per single toilet and lavatory, and a good state of cleanliness.

(B) A house in which the state of cleanliness is good, but which does not provide a few of the facilities included under (A).

(C) A house in which the state of cleanliness is only fair or poor. Otherwise the rating is made on the same basis as (B).

(Unsatisfactory) A house in which the rooms are considered unhygienic due to lack of cleanliness or adequate facilities for housing.

The size of the rooms varied to such an extent that it was found impractical to establish any single standard for the maximum number of occupants per room. Since such housing factors as water supply, sewage disposal, electrical wiring, fire escapes, gas heaters, screening, and general state of building repair are controlled by state and city ordinances they were not considered as special problems within the scope of this survey. However, there were no houses found in which these conditions appeared to constitute a definite health hazard.

As a result of the data obtained in this investigation the following conclusions are presented:

1. Fifty-five per cent of the inspected houses were rated A, 35 per cent B, 8.9 per cent C, and 1.1 per cent Unsatisfactory.

2. Overcrowded bathroom facilities (more than eight persons per single toilet and lavatory) occurred in 31.2 per cent of the houses.

3. In 41.2 per cent of the houses the students and family shared the same bathroom facilities. The use of the same bathroom facilities by both sexes is undesirable.

4. 4.8 per cent of the total number of rooms inspected were basement rooms.

5. Single beds are rarely provided.

6. In a majority of cases physical overcrowding is due to the request of the student in his effort to reduce living expenses.

7. The inspection was a stimulus to many to make repairs, redecorate, and provide facilities which they otherwise would not have done.

8. In a few instances there was evidence of a state of poor health in the non-student occupants of the rooming house.

9. During the course of this survey several instances of delayed notification of student illnesses came to our notice. These cases concerned students ill enough to be confined in their rooms. In each instance the student had not asked for medical care, and no one else had reported the case.

The modern conception of health is that it cannot be measured entirely in terms of mortality and morbidity rates since it also embraces mental influences that make for a feeling of well being. We feel, therefore, that the general physical elements of rooming houses together with the varied mental attitudes of the rooming house operators exert an influence, favorable or unfavorable, on the health of college students. It would seem that the ideal housing for college students could best be achieved in modern school dormitories or in student directed houses such as well regulated fraternities and sororities.

After making the student rooming house survey, the following practical program for inspection and improvement was presented to the Faculty Council on Student Affairs.

POLICY FOR ROOMING HOUSE INSPECTION

1. Biennial inspection and rating of all student rooming houses under the supervision of the Student Health Service; the women's rooming houses and the men's rooming houses to be inspected on alternate years.

2. Annual inspection of all rooming houses previously rated C or Unsatisfactory.

3. Annual inspection of all new applicants for approval.

4. Investigation of student complaints as received throughout the year.

RECOMMENDATIONS

1. For the school year 1937–1938:

a) That during the inspections the following additional items be recorded: (1) types of bed furnished student roomers, and (2) apparent health of non-student occupants.

b) That all rooming house operators be required to meet the minimum standard of a complete change of linen for each bed per week. Where towels are furnished the minimum requirement shall be two face towels and two bath towels for each student per week.

c) That there be established a maximum number of occupants per room agreed upon by the judgments of the landlady and inspector.

d) That all basement rooms which are not permanently partitioned be placed on the non-approved list.

e) That each rooming house operator be required to report any cases of communicable diseases in the non-student occupants of the rooming house.

f) That each rooming house operator be requested to agree that in cases of student illness in which the student has not voluntarily asked for medical attention, she will report the illness promptly either to a private physician or the Student Health Service. This will enable communicable diseases to be diagnosed early and proper preventive measures instituted without harmful delay. Failure to comply with this request will place the rooming house on the non-approved list.

2. For the school year 1940–1941:

a) That single beds be provided for student housing.

b) That permanent rooming houses renting more than two rooms should provide at least one lavatory and one toilet per eight students and separate facilities for family or house employees.

All rooming house operators have been notified of the additional changes that are to become effective in 1940–1941. The student housing program as proposed for the 1937–1938 school year is now in operation at the College.

Motion Pictures in Health and Physical Education

Sources, Films, Descriptions, and Prices

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THE importance of the eye in learning has long been known. Photography enlivens books, magazines, and advertising; the microscope and telescope reveal worlds formerly unknown; the stereograph and stereoscope present illusions of three dimensions. And now the motion picture, sound and silent, portrays the action and reality of modern life as it is lived today. Experiments show that interest, attention, self-activity, initial learning, and speed of learning are all increased in varying amounts by the use of motion pictures. Unity of subject matter, continuity of thought, retention or permanency of learning are enhanced. Mass instruction is possible and improved.

Fifteen years ago motion pictures were heralded as something that would revolutionize instruction by replacing, in whole or in part, the teachers and the textbooks. Yet, in spite of their demonstrable advantages in education, it is estimated that only ten to fifteen per cent of the public schools of the United States make systematic use of them. Why this lack of popularity of films? In the field of health and physical education several reasons stand out: the lack of suitable films; the cost of rent, purchase, or production; the notion that motion pictures are *entertaining* rather than *educational, toys* rather than *tools, substitutions for* rather than *supplementary to* teacher and textbook.

Only recently have health and physical educators in any considerable numbers begun to make use of sound and silent films. Several steps, however, are necessary before full use can be made of this new aid to instruction. We must:

1. Determine what films are available.
2. Evaluate existing films.
3. Arrange for the production of needed films by
    a) Commercial companies.
    b) National and state services.
    c) Individual schools and instructors.
4. Organize distributing agencies through
    a) Commercial companies.

b) National and state film libraries.

c) Cooperating film libraries among local geographical groups.

5. Teach health and physical educators how to make the best use of films.

PURPOSE

This study is an attempt to perform the *first step* in the field of health and physical education. In the general field lists of sources are available or are now being prepared, i.e., the National Visual Instruction Survey, The Educational Film Catalogue, the master catalogue of the American Council on Education, the yearly directory of the *Educational Screen,* and others.

A tentative list of films in health and physical education is presented below. Over two hundred sources were canvassed. Approximately seventy-five had no films in this field and an additional fifty failed to respond to two requests for information. Sources, titles, number of reels, prices, and brief descriptions are included. Because of the unprecedented growth in the number and variety of films, omissions doubtless occur.

The *second step,* i.e.,the evaluation of existing films, is not attempted here. Examples of beginnings in this direction are the work of the Committee of the Women's Athletic Section of the American Association for Health and Physical Education, and the Educational Committee of the Motion Picture Producers and Distributors Association of America, Inc.

Production of motion picture films, the *third step,* is growing rapidly, although somewhat haphazardly, among commercial companies and also in individual institutions. Both groups are experimenting with various types of cameras, lenses, lighting effects, and other factors. In physical education there is great opportunity for instructors to film the performance, good and bad, of their own students and compare with films of champion performers. We need to know what type of films are wanted and needed by our teachers, and some degree of uniformity of production would also seem desirable.

The *fourth step,* i.e., organizing distributing agencies is one of the best present solutions to the high cost of motion picture films. While the cost of projection equipment, $60 to $450, is small when compared to amounts expended for libraries, laboratories, and gymnasium and athletic equipment, the real cost is in providing films, which at most are used only once or twice each year. Since a silent film costs about $25 and a sound film approximately twice that amount, an adequate stock would amount to hundreds or several thousands of dollars. *A cooperative film library* has solved this problem where schools have banded together, each member contributing at least one film to the library. Once started this plan usually grows with amazing rapidity.

The *fifth step* is probably the most important of all. Our teachers must learn how to make the best use of films. Courses of study should

be analyzed to determine where a particular film fits in so that it may be obtained at the opportune time. All this demands preparation in advance, including the determination of just what is to be learned from the film, careful selection according to established standards, previews, oral introductions or other approaches, explanatory discussions, re-showing, supplementary materials, follow-up activities, and tests.

It is hoped that this attempt at step one, the listing of available films, will lead eventually to the completion of the other steps.

SUGGESTIONS FOR USING FILMS

1. Order at least a month ahead of scheduled showing.
2. Name several alternates; substitutes will be sent by the companies.
3. Rental prices are quoted for one day's use only. Additional charge is made for each additional day.
4. Users pay the transportation charges both ways on free films. All shipments should be insured as the user is held liable for any damage to films while in transit.
5. The user is liable for any damage to films while in his possession. Prompt report should be made on the condition of films when shown.
6. Do not rewind films after the last showing, as the owner checks for damage when rewinding film.
7. Write to your State Education Association, State Health Department and State University (Bureau of Visual Instruction, University Extension Division) for a list of their films. These sources have many films for use in their own state at a very reasonable rate in comparison to those of commercial sources.

HEALTH EDUCATION FILMS[1]

I. ANATOMY AND PHYSIOLOGY

Action of the Human Heart. Bray ⅓ reel, rent $1.00; sale $10.70; Y.M.C.A. 500 ft. rent $1.50. Animated diagrams of the complete circulation of the human body; explains the valvular action of the human heart.

An X-ray on Teeth. Bray ⅓ reel, rent $1.00; sale $7.50. X-ray photographs of infected tooth sockets and other curable diseases of the mouth; their destructive effect upon health; importance of care and frequent examination.

Blood, The. Eastman ¾ reel, sale $18.00; Gaumont British 16mm. and 35mm. sound, no price stated; Wisconsin 1 reel $1.00, includes teachers guide; California University rent $1.00; Akin $1.00. Illustrates the separation of plasma from blood cells, protein and salts from plasma; staining cells; counting red blood corpuscles; how white blood cells reach the body tissue. Clotting of blood.

Blood Circulation and Composition. New York State 4 reels 35mm., free. A technical picture on heart action, circulation, and composition of the blood. Technical, but excellent for schools. Each reel can be shown separately if desired. Write for synopsis.

[1] 16 mm. and silent unless otherwise stated. A subject index of the classifications will be found at the end of the article, page 153.

Blood Vessels and Their Functions. California University 1 reel, rent $1.50. Vascular systems illustrated by actual dissection of main blood vessels and by animated drawings.

Body Defenses Against Disease. Erpi 1 reel sound, sale 16mm. $50.00, 35mm. $100.00. The film provides an exposition of the three lines of defense—the skin, phagocytic cells, and lymphatics of the blood, including a section on immunology.

Body Framework. Eastman 1 reel, sale $24.00; Wisconsin 1 reel, rent $1.00 plus teacher's guide; Akin $.50; California $1.00. Shows how the skeleton determines shape and size of the body, and how it protects the vital organs. Demonstrates details of bone structure and composition, changes during growth, mending of a fractured bone, relation of sunlight and cod-liver oil to bone development, and joint action.

Breath of Life. Edited 1 reel, rent $1.50. Processes of transportation of oxygen from the air to the lungs; the supply used and how plant life plays its part in maintaining the supply.

Breathing. Eastman 1 reel, sale $24.00; Kansas University rent $.50; Wisconsin rent $1.00 includes teacher's guide; Akin $.50. Excellent scenes and animations stress the importance of good lungs, and explain the action of the diaphragm, breathing, lung structure, and function.

Breathing. Gaumont British 450 ft. 16mm., 1125 ft. 35mm. sound. A carefully thought out explanation by means of the screen of the correct way to breathe and the importance of breathing to health.

Circulation. Eastman 1 reel, sale $24.00; Gaumont British 324 ft. 16mm.; Kansas University rent $1.50; Iowa University rent $1.00; Wisconsin rent $1.00 includes teaching guide; Akin $.50. Animations and photography trace the human circulatory system. Compare the human heart with that of a frog, and show the cycle of pulmonary circulation.

Circulatory Control. Eastman 1 reel, sale $24.00; Wisconsin rent $1.00; Akin rent $.50; California University rent $1.00. Illustrates the pressure of blood in the arteries; methods of measuring blood pressure; the structure and work of the veins; and nature's method of vasomotor control.

Digestion. Eastman 1 reel, sale $24.00; Iowa University rent $1.00; Kansas University rent $1.50; Wisconsin $1.00 includes teaching guide; Akin rent $.50; California University rent $1.00. Covers the complete digestive tract showing action of saliva upon food, swallowing, stomach structure, digestion of food, and the structure and action of both intestines.

Ear—Communication, The. Akin 1 reel, rent $.50. All parts of the ear are explained by diagrams and compared to the receiver in a telephone. Sound waves are illustrated.

Eye—Camera, The. Akin 1 reel, rent $.50. Anatomy and functions of the eye is compared to the lenses of the camera. Diagrams explaining and illustrating how we see.

Eyesight. Institutional Cinema Service, rent $1.50, sale $24.00; Iowa University $1.00; Kansas University rent $1.50; California University rent $1.00. The aim of this film is to show the delicate structure of the organ of sight, its relation to the outside world and to the brain, the necessity of protecting the eyesight by the avoidance of strain or neglect, and to establish right habits for the preservation of good eyesight.

Heart and Circulation of the Blood. Erpi 1 reel, sound 16mm., sale $50.00, 35mm. sale $100.00. This production deals with the mechanics of the pulmonary and systemic systems. Amplified heart beat sounds and microscopic scenes of capillary action render the picture spectacular.

Heart Action and Blood Circulation. Edited, 1 reel, rent $1.50. Origin of the heart beat and inherent qualities of heart muscle contraction in early chick embryo;

the course of blood and lymph through the human body; action of a living heart (turtle); expansion and contraction of arteries, arterial, venous and capillary flow of blood in chick embryo.

Heart and How It Works. Edited 1 reel, rent $1.50; California rent $1.50. Dissections of the human heart, demonstrating construction of chambers, partitions, valves, and cords; valvular action.

House of Vision, The. New York State talking slide film, free. Defective vision, importance and care of the eyes, and correction of defects.

How's Your Eyesight? Bray ½ reel, rent $1.00, sale $11.79; Y.M.C.A. 500 ft., rent $1.50. Explains common ailments of the human eye, the causes, and remedies, and combines animated diagrams with actual photography. Excellent for teaching purposes.

How Teeth Grow. American Dental Association 1 reel, rent $1.00; Eastman sale $24.00; Iowa rent $.35; Wisconsin rent $1.00 with teacher's guide; Akin rent $.50. This film traces the development of teeth from infancy to adult life, showing their structure and arrangement.

How the Fires of the Body are Fed. Films of Commerce, sale 16mm. $24.00, 35mm. $75.00; Institutional Cinema Service rent $1.50, sale $24.00; Pinkney 16mm. rent $1.50-$2.00, sale $23.00, 35mm. rent $2.50-$3.00, sale $65.00; Edited $1.50. A study of the mechanical processes that take place in the human body during digestion. A striking comparison between the stoking of a ship and the feeding of the human body, is drawn. X-ray photographs of the stomach in action are shown.

How We Breathe. Bray ½ reel, rent $1.00, sale $15.20; Iowa rent $1.00; Y.M.C.A. 500 ft. rent $1.50 per day, $2.50 two days, $5.00 for five days; California $.75; Edited $1.50. Animated drawing showing formation of the human lungs and how they function in purifying the blood.

How We Hear. Bray ⅓ reel, rent $1.00, sale $8.82; Kodascope on reel with "The Human Voice" rent $1.25; Y.M.C.A. 500 ft. rent $1.50; Edited includes "Human Voice" $1.50. A scientific exposition of the manner in which sound waves enter the human ear and are translated into brain impressions. Partly in photographs and partly in animated drawings of the outer, the middle, and the inner ear.

How We See. Kansas University 1 reel, rent $1.50.

How You See. Bray ⅓ reel, rent $1.00, sale $10.28; Y.M.C.A. 500 ft. rent $1.50; Edited with "How's Your Eyesight" $1.50. Animated diagrams and photography explain the theory of sight; principles common to the eye and to the combination of lens, diaphragm, and sensitive plate of the camera.

Human Body Series. Bray 5 reels, rent $8.00, sale $150.00.

I. The Digestive Tract (1 reel, rent $2.00, sale $35.00).
II. The Respiratory and Urinary Systems.
III. The Heart and How It Works.
IV. The Blood Vessels.
V. Human Development.

Human Voice. Bray ⅔ reel, rent $1.50, sale $16.52; Kodascope 216 ft. on same reel with "How We Hear" rent $1.25; Y.M.C.A. 500 ft. rent $1.50; Akin rent $.50; California rent $.75. A scientific subject showing partly in regular photography and partly in animated drawing the functions of the tongue, larynx, epiglottis, vocal chords and other organs in forming words and word sounds.

Living Cell, The. Eastman 1 reel, sale $24.00. Pictures the division and growth of single celled organisms; yeast, amoeba, paramecium—many celled organisms; hydra and flatworm—tissue cells.

Man. California University 1 reel, rent $1.00. Amoeba, the lowest form of life; man, the highest. Diagram showing the heart, lungs, alimentary canal, stomach, nervous system, eye, ear, etc., and how they are connected with the brain.

Marvel of Vision, The. New York State talking slide film, free. Similar to *The House of Vision.*

Mechanisms of Breathing. Erpi 1 reel, sound 16mm. sale $50.00, 35mm. sale $100.00. In this picture the breathing mechanism in operation is revealed. Technical animation portrays gaseous exchange in the lungs and body tissue cells, including pathological conditions. A demonstration of artificial respiration is provided.

Mechanics of Breathing. California University 1 reel sound, rent $1.50.

Muscles. Eastman 1 reel, $24.00; Wisconsin rent $1.00 includes teacher's guide; Akin rent $.50; California rent $1.00. Strikingly presents the general nature and structure of muscles—voluntary and involuntary. Contraction, effect of a series of stimulations, nature of sustained contractions, recording of muscle fatigue; arrangement of muscles in antagonistic groups, use of muscles in various activities.

Nature—Builder of Teeth. American Dental Association rent $1.00, sale $25.00. One reel shows the development of teeth from birth to adulthood. Explains the part played in facial development by the erupting forces of teeth; also effect of nutritional disturbances and illness on tooth development; mottled teeth, normal and abnormal occlusion, are portrayed. Written lecture accompanies film.

Nervous System, The. Erpi 1 reel, sound 16mm. sale $50.00, 35mm. sale $100.00. The structure of the nervous system, together with its pathways and connections is depicted. The nature of the nerve impulse; conditions for setting up impulses; their passage from cell to cell; their discharge and resultant activity are shown along with reflexes, sensory integration, and finally, activity of the cerebrum.

Physiology of Mastication, The. American Dental Association 2 reels, rent $2.00. Study of jaw movements of various animals exhibiting types of mastication as an introduction to study of human beings. Animated skulls and cartoons are synchronized with mandibular movements of animals.

Precipitins. Edited ½ reel, rent $1.50. Biologic observations illustrating the specific differences prevailing among animal and human proteins and their usefulness in detecting the relationship of various blood groups.

Pounding the Pavement with Lowell Thomas. Wright E. T. 2 reels, sale to medical associations. This film is designed principally to illustrate and explain the structure of Wright Arch Preserver Shoes, to retail sales people.

Reproduction in Higher Forms. Edited 1 reel, rent $1.50. Reproduction in fish, reptiles, birds and mammals, including ovulation, fertilization, development, and nourishment of the embryo. Delicately yet straightforwardly handled for school use.

Respiratory and Urinary Systems. California University 1 reel, rent $1.50. Respiratory System—Animated drawings show the location and inter-relation of the respiratory organs. Dissection and demonstration of the lungs. The passage of the air through the lungs and its distribution by the blood to all parts of the body. Urinary System—The entire urinary system is dissected and assembled outside the body so that it can be studied. The relation of the urinary tract to the circulatory and other systems is shown.

Seeing How You See. Belgard-Spero Company 1 reel, rent $5.00; Wisconsin, free. Shows the mechanics of the eye and the common physical defects which may be remedied through the proper examination and the fitting of glasses.

Through Life's Windows. Institutional Cinema Service 1 reel, rent $1.50, sale $24.00. The film shows by animation, by actual examples, and by comparison with camera lenses, the structure, operations and functions of the human eye. Technically correct in every detail, yet told with the utmost simplicity.

Valves of the Heart—In Action. American Heart Association 1 reel 16mm., rent $1.00 per week, sale 16mm. $15.00, 35mm. $20. Animated diagrams explain and

amplify the scenes of the heart valves as well as the flow of the blood and the action of the heart muscle.

Vision. Gaumont British 396 ft. Made with the cooperation of the National Ophthalmic Treatment Board. The structure of the eye is shown in detail by means of models and diagrams, and the working of the eye is explained by an examination of the optical system of a camera, together with structural changes indicating short or long sight and the correction and relief given by correct glasses.

II. COMMUNICABLE DISEASES

Armies of Health and Disease. DeVry 1 reel, sale $24.00; Institutional Cinema Service rent $1.50, sale $24.00; Mogull rent $.50; Y.M.C.A. rent $1.50; Edited $1.50. The development of bacteria in a biological laboratory; a brief account of the life of Pasteur; pasteurization for preservation of food; chickens innoculated with bacterial cholera cultures; experiments in the development of vaccination; rabies yields to Pasteur.

Bacteria. Eastman ¾ reel, sale $18.00; Wisconsin rent $1.00 includes teaching guide; Akin rent $.50. A culture medium is made, and bacteria from vinegar, water, rich earth, and dust are carefully grown, and subsequently strained and examined.

Behind the Shadows. Hudson County Tuberculosis League 1 reel sound, free; New York State sound, free; National Tuberculosis Association sale 16mm. sound $12.00, silent $9.00, 35mm. sound $25.00, silent $23.00; New Jersey Tuberculosis League, free. A doctor explains to a group of high school boys and girls what tuberculosis is. As he speaks off-stage, pictures, X-rays, and animated diagrams illustrate his story.

Clean Herds and Hearts. United States Department of Agriculture 3 reels, free. Pictures how a community campaign for the eradication of animal tuberculosis is organized and conducted; relation of animal tuberculosis to human health; economic losses due to the disease.

Confessions of a Cold. National Motion Picture Company 1 reel, rent $1.50, sale 16mm. $40.00, 35mm. $100.00; New Jersey Tuberculosis League, free. A cold sprite, overcome by remorse reveals the inmost secrets of his kind, showing the cause, effect, cure and prevention of colds, combining animation and regular scenes. The lesson is made interesting because it is told from the standpoint of the culprit himself, taking on all the glamor and fascination of a confession.

Conquering Diphtheria. Institutional Cinema Service 1 reel, rent $1.50, sale $24.00; Society for Visual Education rent $1.50. This film presents in simple form the scientific facts concerning diphtheria and the method by which science has first developed a cure for the disease and later a means of prevention.

Conquest of Diphtheria. Hudson County Tuberculosis League 1 reel, free; Metropolitan 16mm. and 35mm., free; Y.M.C.A., free. Skipper, aged four, has fallen ill. As there are many cases of diphtheria in town the Doctor is called in. Precautions are taken and Skipper is given his first injection for diphtheria immunization. The film fades back to little Betty and Johnny Adams in 1860, showing how, because of the lack of preventative measures, Betty Adams lost her life from diphtheria. The Doctor also tells the story of Von Behring's first antitoxin injection in 1891, which is portrayed in a Christmas scene. The next generation of Betty and John Adams is shown in 1900 saved by antitoxin. The doctor then shows how simply we can prevent diptheria by toxin-antitoxin or toxoid.

Consequences. New York State 1 reel, free; New Jersey Tuberculosis League, free. A popular picture on the early diagnosis of tuberculosis which teaches the lesson that "early discovery hastens early recovery." Suitable for any audience

and very helpful in tuberculosis campaigns. Interesting, clear-cut story with a happy termination.

Delay Is Dangerous. New Jersey Tuberculosis League 1 reel, free. Illustrates the importance of early diagnosis from the patient's viewpoint. Tells in story form how the poster "You May Have Tuberculosis" brings about a man's cure.

Diphtheria. Eastman 1 reel, sale $24.00; Wisconsin rent $1.00 includes teacher's guide; Akin rent $.50. A diphtheritic throat is compared with a normal one. The complete preparation and use of antitoxin are demonstrated. Methods of modern diphtheria control and of preventing the disease by the administration of toxin-antitoxin are shown.

Disease Carriers. DeVry 1 reel, sale $24.00; Y.M.C.A. 2 reels, rent $1.50; California University rent $1.00.

House Fly, The. Eastman 1 reel, sale $24.00; Erpi sound, sale 16mm. $50.00, 35mm. $100.00; Wisconsin rent $1.00 includes teacher's guide; New Jersey Tuberculosis Association, free; California $1.00. The film tells the complete story of this common but extremely dangerous pest.

How Disease Is Spread. Mogull 1 reel $.50; Edited rent $1.50. A series of dramatic episodes showing how bacterial infection is transmitted.

Kid Comes Through, The. Akin 1 reel, rent $.50. A National Tuberculosis Association reel illustrating the value of good food, fresh air, exercise, and proper health habits for physical fitness.

Man Against Microbe. American Museum Natural History 1 reel, free; Metropolitan Life sound 16mm. and 35mm., free; Y.M.C.A., free. Dramatizes the successful wars of science against disease by presenting a number of the principal events which led to the creation of modern medicine.

One Scar or Many. F. C. Pictures 1 reel 35mm., rent $3.00. The need for vaccination; illustrated with animated diagram showing comparative results in groups of children vaccinated and those not vaccinated.

Preventing Diphtheria. John Hancock 1 reel, free. This film emphasizes by a short drama the importance of immunization against the disease; the Schick Test is illustrated; and animated graphs show what has happened in the communities where the school children have been immunized.

Preventing the Spread of Disease. National Motion Picture Company 1 reel, rent $1.50, sale 16mm. $40.00, 35mm. $85.00. Comparing the spread of disease to the creation of a chain of micro-organisms. This one-reel film shows us various ways by which the chain is created and the steps which should be taken by which it may be broken.

Question of Health. New York State 1 reel 16mm. and 35mm., free. Deals with the subject of tuberculosis and urges examination if there is any doubt about general health. Entertaining and instructive story throughout bringing in the good work of tuberculosis and health associations in prevention and early diagnosis of tuberculosis. Also has good publicity for Christmas seals.

Science of Life, The. Bray 5 reels in series entitled Section II, "Communicable Diseases." Rent per reel $2.00; sale per reel $35.00.

Reel V: *How Plants and Animals Cause Disease.* Types of bacteria and the diseases they cause; antiseptics; animal parasites; sterilization; action of white corpuscles; tuberculosis bacteria—fresh air and sunshine their enemies.

Reel VI: *How Disease is Spread.* A series of dramatic episodes showing how bacterial infection is transmitted through carelessness in the ordinary contacts of life; spread of infections; necessity of careful habits, and the proper cleaning of food materials.

Reel VII: *How to Prevent Disease.* Contamination of water supply through ignorance and carelessness; reduction of death rate following preventative measures; pasteurization; quarantine; vaccination; antitoxin; Schick test;

death rates from prevalent contagious diseases; venereal disease and the need for open, courageous discussion thereon.

Reel VIII: *How the Mosquito Spreads Disease.* Life story of the mosquito; malaria parasite and its cycle in the mosquito and in human blood. Prevention of malaria and yellow fever.

Reel IX: *The Fly as a Disease Carrier.* Life history of the housefly and its structure, especially of feet, proboscis and crop as related to spread of bacteria; breeding and feeding habits; practical suggestions toward extermination.

Sniffles Snuffles. New York State 1 reel, free. Showing the communicability of the common cold and its dangers.

Story of My Life by Tee Bee. Hudson County 1 reel, free; National Tuberculosis Association sale 16mm. $10.00, 35mm. $30.00; New Jersey Tuberculosis League, free; New York State, free. Old "Tee Bee," the germ that causes tuberculosis tells the story of his life in the form of an animated cartoon.

Stung! By Amos Quito (Mosquito). Bray ⅔ reel, rent $1.50, sale $15.43. Valuable public information on preventing malaria made with cooperation of United States Public Health Service, Bureau of Fisheries, and American Museum of Natural History.

Suppressing the Foot and Mouth Disease. United States Department of Agriculture 2 reels, free. Prevalence of foot and mouth disease in many foreign countries; outbreaks of the malady in this country in 1914 and 1924; the control, radical but effective method and necessity of public cooperation .

Tuberculosis and How It May Be Avoided. Eastman 1 reel, sale 16mm. $24.00, 35mm. $75.00; New Jersey Tuberculosis League, free. By scenes and animations, tubercle bacilli are shown growing in the laboratory and in the lung tissue of the human body. A tuberculin test is given, a positive reaction is obtained, and the daily routine at a preventorium is pictured.

The War on the Mosquito. National Motion Picture Company 1 reel, sale 16mm. $40.00, 35mm. $100.00. A motion picture that makes a really valuable contribution to the educational propaganda on public health. The subject is full of human interest, with the "punch" to bring about the cooperation of the public in the extermination of this health menace.

III. COMMUNITY SANITATION

Clean Up. Mogull 1 reel, $.50. How school children take part in clean-up-the-community campaigns.

Coney Island. Y.M.C.A. 1 reel, free. The famous resort, with a strong plea for the protection and proper use of public property.

Denver Water Supply. Akin 3 reels, rent about $1.25.

Reel 1: Introduction to Denver Municipal Water Board in session. The picture then opens with water dripping from a glacier above timberline in the land of perpetual snow. We follow the course of this water through three reservoirs and into the first conduit at Marston Lake where it is screened, aerated, filtered, and chemically treated.

Reel 2: Laboratory scenes showing chemical tests with microscope; culture test for bacteria, etc. Typhoid fever graph shows the decrease in death rate since water has been more carefully treated. Scenes of reservoirs, distributing stations and pumping plants.

Reel 3: Denver's outlook for future water supply. Because of irrigation rights Denver looks to the Western slope for water for future needs. Views of Moffat Tunnel diversion project emphasizing the extent to which man will go to get this necessity of life—Water.

Disease Carriers. Institutional Cinema Service rent $1.50, sale $24.00. See "Community Diseases" for other sources; Akin $.50. The life history of the fly, a

germ carrier; breeding places; breaking through the pupa case; the fly's eye and foot; how the fly carries disease germs; contaminated drinking water; a modern disposal plant; rats as disease carriers; methods of rat control; the mosquito; a malaria infested district of Italy being restored to usefulness by control of the mosquito.

Drinking Health. American Museum Natural History 2 reels, free; Films of Commerce free, sale 16mm. $48.00, 35mm. $150.00; Institutional Cinema Service rent $1.50, sale $24.00, 1 reel; National Motion Picture Company 2 reels, sale 16mm. $40.00 per reel, 35mm. $200.00; Pinkney rent 16mm. $1.50 or $2.00, 35mm. $2.50 or $3.00, sale 16mm. $23.00 per reel, 35mm. $65.00 per reel; Wisconsin free; Y.M.C.A. free; New York State free. The film shows how nature provides for quenching our thirst, the great government enterprises established to supply us with pure drinking water and the needs and uses of water by the human body. The dangers of contamination from unclean drinking vessels are then shown, with suggestions by the United States Public Health Service and other medical authority on how to avoid these dangers, vividly illustrated by action scenes and microscopic photography.

Drink of Water. Akin ½ reel, rent $.25. Stressing the value of good drinking water.

Filter, The. Gaumont British 1 reel sound, 16mm. and 35mm. Showing how Science has had a great long-drawn-out battle to achieve the victory of pure clear water in our domestic taps.

Fly As a Disease Carrier, The. Edited 1 reel, rent $1.50. Life history of the housefly and its structure as related to the spread of bacteria. Practical suggestions toward extermination.

Fly Danger. National Motion Picture Company 1 reel, rent $1.50, sale 16mm. $40.00, 35mm. $75.00. A film for everyone about and against the fly. Technical details are skillfully interwoven with human interest material.

Fly Follow-Up, A. New York State 1 reel, free. Deals with the fly nuisance.

Getting Acquainted With Bacteria. Institutional Cinema Service 1 reel, rent $1.50, sale $24.00; Society Visual Education rent $1.50. This reel is an excellent foundation for lessons both in sanitation and nature study. It introduces the child to the wonderful field of microscopic organisms and shows that most of the bacteria are as harmless as buttercups and daisies.

Home Is What You Make It. United States Department of Agriculture 3 reels, free. A story picture showing how a dilapidated house may be improved by repairs, painting, and landscaping.

How To Get Rid of Rats. Wisconsin 1 reel, rent $.50; California $1.00. Various methods of rat control. Some unusual views of wild rats in action.

How the Mosquito Spreads Disease. Edited 1 reel, rent $1.50. Life history of the mosquito; malaria parasite and its cycle in the mosquito and in human blood. Prevention of malaria and yellow fever.

In His Father's Footsteps. F. C. Pictures Corp. 1 reel 35mm., rent $3.00. Shows the need for sanitary measures on a farm.

Keeping Out Bad Food. United States Department of Agriculture 1 reel, free. Inspection of imported food under the Food and Drugs Act as a protection against fraudulent and unwholesome articles; inspection of tea under the Tea Act.

Milk Mischief. New York State 1 reel, free. Showing the possibilities of infection by milk and importance of care in production and handling.

Mold and Yeast. Eastman ½ reel, $12.00. Specimens of mold on fruit, leather, clothes, and bread. The way in which molds grow, develop, and germinate and the formation of buds and new plants of mold—like yeast.

Mosquitoes. California University 3 reels, rent $.75.

Mosquito, The. Society Visual Education 1 reel, rent $1.50-$2.00. This reel rounds out one's intimate acquaintance with the aggressive mosquito.

Mosquito Control. Y.M.C.A. 1 reel, free. The C.C.C. at work.

Mosquitoes. United States Department of Agriculture 3 reels, free. Points out the baleful influence of mosquitoes on both human and animal life, traces their life history, and discusses method of control.

Mosquitoes—Public Enemy, The. United States Department of Agriculture 2 reels sound only, free. Discusses the mosquito as a pest affecting man and beast, varieties and life history, safeguards and methods of control.

Now You're Talking. Y.M.C.A. 1 reel, free. An animated cartoon illustrating the harm that may result from improper handling of the telephone.

Old Jake Wakes Up. United States Department of Agriculture 1 reel, free. Designed to awaken interest in the spring clean-up campaign and to supply comedy for corn-borer meetings.

Our Common Enemy—The Fly. Films of Commerce 1 reel, sale 16mm. $24.00, 35mm. $75.00; Institutional Cinema Service rent $1.50, sale $24.00; Kansas University rent $1.50. A motion picture study of the house-fly in which every stage of development from the egg to maturity is shown, magnified hundreds of thousands of times. A striking feature is the detailed study of the fly's marvelous eyes with their thousands of tiny lenses.

Purifying Water. Mogull 1 reel, rent $.50; Kansas University rent $1.50; Wisconsin rent $1.00 includes teacher's guide; Y.M.C.A. rent $1.00. Analyses are pictured illustrating the inherent and acquired impurities of water and methods of disinfection, filtration, aeration and final testing of a city's water supply.

Rat Menace, The. National Motion Picture Company 1 reel, sale 16mm. $40.00, 35mm. $75.00. A forceful educational motion picture, showing the habits of the rat, how rats spread disease, damage millions in property, and how to exterminate them.

Serving the Community (Part I). California University ½ reel, rent $.50. Mary Willis has typhoid fever, the principal of her school explains the causes and tells of the housefly as a common carrier. The school plans a campaign against the fly. (Elementary).

Serving the Community (Part II). California University ½ reel, rent $.50. The housefly campaign is started by mapping out the town and breeding spots. Canvass locates places. Individual owners are forced to clean up. (Elementary).

Sewage Disposal. Eastman 1 reel, sale $24.00; Mogull $.50; Wisconsin rent $1.00 includes teacher's guide; Y.M.C.A. rent $1.00; California University rent $1.00. Deals with purification by Imhoff tank and sprinkling filter—purification by sand filtration—discharging sewage into the ocean with the ebb of the tide.

Sewage Treatment Plants—New York State Institutions. New York State 1 reel, free. Shows four different methods of sewage treatment in State Institutions. Suitable for high school, college, and general audiences.

Singing and Stinging. Films of Commerce 1 reel, sale 16mm. $24.00, 35mm. $75.00; Institutional Cinema Service rent $1.50, sale $24.00. The life story of the mosquito in images hundreds of thousands times larger than natural size.

Stung Mosquitoes. Pinkney 1 reel, 16mm. rent $1.50-$2.00, sale $23.00, 35mm. rent $2.50-$3.00, sale $65.00.

Water. California University 1 reel, rent $1.00. Natural properties. Power and support of life as used by man. Irrigation, water supply, and power system.

Waste Disposal in Cities. Institutional Cinema Service rent $1.50, sale $24.00; Society for Visual Education 1 reel, rent $1.50. The two principal methods. One system illustrates waste stored in tanks until the tide goes out, then discharged into the ocean. The other system illustrates purification through bacteriological action.

Work of the United States Public Health Service, The. Bray 7 reels, rent $20.00, sale $300.00; individual reels rent $3.00, sale $50.00. Produced under the direction of the Public Health Service, this film tells the story of the Service

from its simple beginnings in 1798 down to the great, far-flung organization of today.

Reel I: *History and Duties.* Prevention of introduction of diseases from abroad.

Reel II: *Prevention of Introduction of Diseases from Abroad* (Continued). Bubonic Plague. Prevention of interstate spread of disease and suppression of epidemics.

Reel III: *Trachoma.* Cooperation with State and County Health authorities.

Reel IV: *Cooperation with State and County Health Authorities* (Continued). Keeping informed on prevalence of disease. Investigation of diseases of man.

Reel V: *Discovery of the Cause of Pellagra.* Tularemia. Rocky Mountain Spotted Fever. Parrot fever.

Reel VI: *Typhus Fever.* Public Health aspects of Venereal Diseases. Marine Hospitals and medical care of beneficiaries of the Public Health Service.

Reel VII: *Marine Hospitals and Medical Care of Beneficiaries of the Public Health Service* (Continued). National Leprosarium at Carville, Louisiana; medical advice to ships at sea. Medical services in Federal penal and correctional institutions. Narcotic farm at Lexington, Kentucky.

IV. HOME NURSING AND CHILD CARE

Babies Bath and Toilet. National Motion Pictures Company 1 reel 35mm., sale $100.00; California State Department of Public Health 35mm., free. A valuable motion picture contribution to public health education on child hygiene.

Babyhood. F. C. Pictures 1 reel 35mm., rent $3.00. The need for proper care of children in infancy.

Baby's Day at Twelve Weeks. Erpi 1 reel sound 16mm., rent $3.50, sale $50.00, 35mm. rent $5.00, sale $100.00; Wisconsin rent $1.00. In this picture the infant is followed through his domestic day from the time of his waking at six o'clock in the morning until the final breast feeding at ten o'clock at night.

Baby's Day at Forty-eight Weeks, A. Wisconsin 1 reel sound, rent $1.00; "A Behavior Day at Forty-eight Weeks," Erpi 16mm., rent $3.50, sale $50.00, 35mm. rent $5.00, sale $100.00. In this reel the observer has an opportunity to make fuller comparisons of the effects of age on the infant's everyday life. Wholesome methods of child care are portrayed in numerous situations including the administration of cod liver oil and orange juice, the bath, dressing, feeding, elimination, floor play, and daytime naps and sleeps.

Best-Fed Baby. California State 1 reel 35mm., free; New York State, free. Produced by the Children's Bureau to show the importance of breast feeding. A narrative of two young mothers showing the right and wrong way of feeding babies.

Big Gains for Little Bodies. Iowa University 1 reel, rent $.35; New York State, free. This film shows the necessity of proper food, rest and fresh air to the underweight child, stressing the value to this group of life in the health camps. It can be used with adults or with children.

Food Makes a Difference. United States Department of Agriculture 2 reels, free; Y.M.C.A. rent $1.50. This film is addressed to parents. It shows how by experiments scientists have learned to feed plants and animals so as to insure best growth. Pictures of the effect of proper feeding on both animals and children make a strong plea to parents to feed their children as carefully as farmers feed their stock and their crops.

Garden of Childhood, The. John Hancock 1 reel, free; Wisconsin, free. Depicts a well-ordered routine of rest, play, sleep and physical inspection for pre-school children.

Good Hospital Care. American College of Surgeons 16mm. sound, free.

Home Nursing—The Bed Bath. Eastman ½ reel, sale $12.00. Demonstrates the technique of bathing a patient in bed, and of making the bed while occupied.

Home Nursing—Routine Procedure. Eastman 1 reel, sale $24.00; Wisconsin 1 reel, rent $1.00 includes teacher's guide. Covers routine procedures in the care of convalescent people. The units are (1) Taking temperature, pulse, respiration; (2) Preparing patient for breakfast; (3) Serving food; (4) Preparing patient for the night.

Home Nursing—Special Procedures. Eastman ¾ reel, $18.00; Wisconsin 1 reel, rent $1.00 includes teaching guide. Some special procedures for relieving special conditions. The units are: cold compresses; applying hot stupes; giving a foot tub to a patient in bed; flaxseed poultice; inhalations.

Little Brothers and Sisters. Institutional Cinema Service, rent $1.50, sale $24.00; Iowa University 1 reel, rent $1.00; DeVry sale $24.00; Edited $1.50. The specific aim of this lesson is to give information on the care of infants and young children so that such pupils as must care for their younger brothers and sisters may do so intelligently. Care is also taken to tie these practices up with the health habits which the children themselves should practice and thereby emphasize health habits as a life long practice.

Solid Foods in the Infant Dietary. Libby, McNeill and Libby sound and silent, free.

Thirty-six Weeks Behavior Day. Erpi 1 reel sound 16mm., rent $3.50, sale $50.00; 35mm. rent $5.00, sale $100.00. The infant boy whose behavior day at 12 weeks was charted is now 36 weeks old. He has made striking progress. His reactions are compared with those which he experienced twenty-four weeks earlier.

Well Born. California State Department of Health 2 reels 36mm., free.

Your Baby. National Motion Picture Company 1 reel, rent $1.50, sale 16mm. $40.00, 35mm. $85.00.

V. NUTRITION

A.B.C. of Food, The. Iowa 1 reel, rent $.35. Suitable for use with adults or high school groups. The simple facts about the value and purpose of the various types, amply and richly illustrated. The body is compared with an engine and combustion with digestion.

Along the Milky Way. Borden's Farm 1 reel, free with lecturer within 60 mile area of New York City; New York State Department of Health 2 reels, free. A picture showing the production and handling of clean milk; an attractive picture for a general audience.

Amazing Vitamins, The. Y.M.C.A. 1 reel, free. The little known story of the vitamins, their public health benefits, and the unique new method of adding the natural vitamin D of cod liver oil to the diet in odorless and tasteless form through Vitamin D milk.

Around the World with the Milkman. American Museum Natural History 2 reels, free; Sheffield Farms Company, free. A milkman who takes his two children on a trip around the world by aeroplane. Milk is carefully strained, tested and shipped to New York where it is pasteurized, placed in sterilized bottles, and delivered to our homes.

Better Milk. Garrison 1 reel sound-on-film, sale $25.00; Edited $1.50.

Bread. Y.M.C.A. 1 reel, rent $1.00.

Dental Nutrition. California University 2 reels, $1.00. Relation of diet to health of teeth. Recent experiments of noted scientists. Results of diet deficiencies. Correct diet.

Feeding New York. Sheffield Farms 1 reel sound, free.

Flour Industry, The. Films Incorporated.

Food. DeVry 1 reel, sale $24.00; California University 1 reel, rent $1.00; Iowa 1 reel $1.00; Y.M.C.A., rent $1.50; Edited $1.50. The specific aim of this lesson is to suggest proper food habits to the pupils. As a background some general information on the digestive system is furnished.

Food and Growth. Connecticut Dairy and Food Council 1 reel, free; Eastman sale $24.00; Iowa rent $.35; New Jersey Tuberculosis League, free; Wisconsin rent $1.00, includes teaching guide. A feeding experiment with white rats, actually carried on in a classroom, demonstrates the food value of milk as compared with coffee and candy.

Food and Health. Institutional Cinema Service 1 reel, rent $1.50, sale $24.00. Foods that supply every need of the body; undernourished children; the food value of milk; care taken to insure a fresh and pure milk supply; testing for butter fat; a pasteurizing plant; bottling the milk; the digestive system and alimentary canal, including the teeth, stomach, and intestines, and the work of each; x-ray effects show how the stomach actually works.

Food from Fowl and Game. Twentieth Century Fox 1 reel 16mm. $25.00, 35mm. $75.00.

Golden Health. American Museum Natural History 1 reel, free; California University rent $.50. A teacher shows his class how the orange was introduced into California.

Good Foods—A Drink of Water. Eastman ½ reel $12.00; Kansas University rent $1.50; Wisconsin rent $.50 includes teaching guide. A horse, a dog, cows, ducks, and a moose drinking. Children at school and play drink from "bubblers" or paper cups and learn to drink water before breakfast. Animated diagram indicates when glasses of water should appear in the day's schedule.

Good Foods—Fruits and Vegetables. Eastman ½ reel, sale $12.00; Iowa rent $.35; Kansas University rent $1.50; Wisconsin rent $.50. Scenes show that vegetables and fruits are relished by animals; rabbits, a hen, birds, a horse, and a boy.

Good Foods—Milk. Eastman ¼ reel, sale $6.00; Iowa University rent $.35; Kansas University rent $1.50; Wisconsin University $.50 includes teaching guide. Scenes at a dairy farm; grazing cows, a suckling calf, the farmer milking, and a boy icing milk. A milkman delivers bottled milk to a city home. Kittens drink milk. A boy enjoys it with his dinner. Children drink it in a school lunchroom.

Greatest Show on Earth. National Dairy Council 2 reels 16mm., rent $5.00 per day $15.00 per week, sale $150.00; 35mm. rent $12.00 per day $34.00 per week, sale $300.00. A humorous presentation built around a children's show presenting Mother Nature as the great magician. Develops the growth-promoting properties of milk.

Guardian of Your Health, The. Y.M.C.A. 2 reels, free. Work and recreation on dairy farms to produce health-giving milk. Suggestions and cooperation by Pure Milk Association.

Her Majesty the Cow. American Museum Natural History 2 reels, free; Hudson County Tuberculosis League, free; Sheffield Farms, free. This film shows the production of milk in England, Isle of Jersey, France, Holland, Switzerland and America.

Milk for You and Me. United States Department of Agriculture 1 reel, free. A four-minute film for use in Milk-for-Health week campaigns. Shows persons of all ages and of all walks of life drinking milk.

Milk Mischief. New Jersey Tuberculosis League 1 reel, free. Cartoon on the value of clean milk.

Milk, The Great White Way to Health. American Museum Natural History 2 reels, free; Sheffield Farms Company, free. An excellent film of the milk industry, details of the care of the cows, modern stanchions and well-kept barn. Care in milking. Testing the milk at receiving stations, transportation to pasteurizing plants. Pasteurization. Bottling and capping and finally the delivery to the city homes.

Milk—The Master Builder. Connecticut Dairy and Food Council, free; National Motion Picture Company, rent $1.50; sale 16mm. $40.00, 35mm. $85.00. A one

reel film dealing with the importance of milk in the healthful diet. It stresses the need for cleanliness in all steps of handling milk and further emphasizes the necessity for pasteurization as a health measure.

Mother Learns Her Lesson. Y.M.C.A. 1 reel, free. How Bond Bread is made.

Nutrition and Dental Health. Mogull 2 reels, $.85.

Our Daily Bread. American Museum Natural History 1 reel, free; Films Incorporated rent $1.00. This educational film visualizes the evolution of our wheat industry. It shows the development of the means of harvesting, threshing, milling and baking, beginning in each case with the primitive and concluding with the most modern apparatus in use.

Out of the Milk Bottle. American Museum Natural History 1 reel, free; Sheffield Farms Company, free. An animated cartoon in which Puny and Plump are the two boy actors. Plump drinks lots of milk and is healthy, but Puny drinks none at all and so is weak and thin.

Pillars of Salt. Films Incorporated 1 reel, rent $1.00. How salt is refined and prepared for the market at one of the largest salt mines in the United States. Many of the scenes were taken 1,000 feet underground.

Rickets. United States Department of Labor film strip, sale $2.00. A series of pictures with explanatory titles showing the effect of rickets on children and how to prevent and cure rickets. The giving of sun baths and cod-liver oil to babies is illustrated and explained.

Science, Guardian of Our Milk Supply. American Museum Natural History 2 reels, free. The first reel of this film shows the cows in the pasture, the cows being examined for diseases, and the milking of cows. The milk is tested for bacteria and butter fat. The second reel shows milk being shipped to the city where it is pasteurized and bottled.

Some Fruits We Like. Twentieth Century Fox 1 reel, sale 16mm. $25.00; 35mm. $75.00.

Sugar Trail, The. Films Incorporated 1 reel, rent $1.00. Beginning with the cultivation of the wild beet, the methods employed in the beet-sugar industry are shown, including the harvesting and manufacturing processes.

Sun-Babies. New York State 16mm. and 35mm. one reel, free; United States Department of Labor, free. A very attractive picture showing the value of sunlight and incidentally of cod-liver oil in promoting growth and preventing rickets.

Team Work. Connecticut Dairy and Food Council, free. Shows how milk is produced from country to city, emphasizes citizenship and teamwork.

Tip Tops in Peppyland. New York State 1 reel, free. A picture which illustrates the importance of milk as a principal source of food elements essential to proper growth and development of the human body. Partly animated.

Victory. American Museum Natural History 2 reels, free; National Dairy Council 16mm., rent $5.00 per day $15.00 per week, sale $150.00; 35mm. rent $12.00 per day $34.00 per week, sale $300.00. For high school age or adults. Uses scientific experiments as basis for convincing athletic boy and girl of the importance of milk in the diet.

Vitamin "Secrets" Revealed. Y.M.C.A. 1 reel, free. Describing little known facts about the food sources and values of vitamins, and the novel method of adding the natural vitamin D of cod-liver oil to bread in the odorless and tasteless form.

Well Balanced Diet, The. National Motion Picture 1 reel, rent $1.50, sale 16mm. $40.00, 35mm. $85.00. A one reel film which deals in a common sense manner with the well balanced diet. It stresses the need for a wide variety of foods to supply the necessary vitamins and minerals and emphasizes the importance of proper cooking, neat serving, and eating in the midst of a proper emotional atmosphere.

VI. PERSONAL HYGIENE—ALCOHOL

Beneficent Reprobate. Y.M.C.A. 4 reels, free. A scientific approach to the facts concerning "Ethyl Alcohol," its nature and its properties.

Chronicle. Harmon Foundation 1 reel. Showing only hands. This is a study of the life of a boy from babyhood until manhood, when he was sent to prison for causing death while driving in an intoxicated condition.

Deliverance. Y.M.C.A. 6 reels rental (apply). A motion picture story adapted for the screen from Professor Irving Fisher's books *Prohibition at Its Worst* (12th edition) and *Prohibition Still at Its Worst* (1928).

Ethyl Alcohol, Its Nature and Its Properties. Y.M.C.A. 3 reels sound, free. A simple but scientifically accurate treatise on the uses and the effects of alcohol in industry and in relation to the central nervous system of the human body.

Story of Marihuana—A Dangerous Narcotic, The. New York State, free. Prepared especially as an aid to narcotic control agents in the identification of cannabis plants, it shows in detail the structure of the leaf and plant; containers commonly employed for concealing and transporting marihuana; pipes, lamps and similar articles used by drug addicts, as well as many other features of practical interest. For police, health and other law enforcement officials only.

VII. PERSONAL HYGIENE—CLEANLINESS

Cleanliness—Bathing. Eastman ½ reel $12.00; Wisconsin rent ½ reel $.50 includes teaching guide; Akin $.25. Birds splash in their tub. Children demonstrate warm baths and cool showers. Scenes show an elephant bathing, a polar bear in its pool, a dog swimming, and finally, children and adults bathing at a beach.

Cleanliness—Clean Clothes. Eastman ½ reel $12.00; Wisconsin ½ reel $.50 includes teaching guide; Akin $.25. Swans preen their feathers. A horse is groomed. A boy polishes his shoes, brushes his coat, takes a clean handkerchief, demonstrates proper use of a napkin. Girls are shown wearing aprons as they help in the home. Scenes indicate proper care of clothing.

Cleanliness—Clean Face and Hands. Eastman ½ reel $12.00; Wisconsin rent $.50 includes teaching guide; Akin $.25. A white cat cleans its paws. Scenes show an approved method of washing the hands, and handwashing at school. A class is inspected for cleanliness.

Cleanliness—Keeping the Hair Clean. Eastman ½ reel $12.00; Wisconsin rent $.50 includes teaching guide; Akin $.25. A dog, a beaver, and a goose take care of their coats. The proper methods of shampooing and drying the hair are shown, as well as the care of brush and comb.

Dangerous Handicap, A. National Motion Picture Company 1 reel, sale 35mm. $100.00. To young girls this film offers a new and very powerful motive for cleanliness—of the person and of the home.

Drifting. National Motion Picture Company 2 reels, sale 35mm. $130.00. A two reel film of sociological as well as of health value. In it we see the often repeated tragedy of the young married couple who, after the first year of aspiration, begin to slide.

How Will You Have Your Bath. Kodascope 299 ft., rent $1.00. Shows a wide diversity of bathing methods.

Red Head. Cereal Soaps 1 reel, free. A "movie" which shows in story form what hair is and how to care for it.

Skin, The. Eastman 1 reel, sale $24.00; Wisconsin rent $1.00 includes teaching guide; California University rent $1.00. Contrasts the skins of various animals. Shows structure and method of growth of human skin. Explains sensation of touch, formation of gooseflesh, how hair stands on end, secretion of sweat, growth of hair and nails. Illustrates proper care of skin.

Soap. Eastman 1 reel, sale $24.00; Wisconsin rent $1.00 includes teacher's guide;

Akin rent $.50. Prepared for use in general science, household chemistry and beginning chemistry classes, this film is designed to acquaint the child with the underlying principle of soap manufacture, the main difference between "hard" and "soft" waters, and the cleansing action of each.

Why Willie Was Willing to Wash. National Motion Picture Company 1 reel, rent $1.50; sale 16mm. $40.00, 35mm. $100.00. An instructive one-reel film showing how a dirty little boy learned of the importance and value of cleanliness.

VIII. PERSONAL HYGIENE—DISEASE

A Call to Arms. New York State (talking slide film), free. Gives some of the leading facts on cancer control measures and contains speeches on the subject by Surgeon General Thomas Parran, United States Public Health Service; Dr. C. C. Little, Managing Director of the American Society for the Control of Cancer. It is educational in material and contains no unpleasant features.

Tuberculosis and How It May Be Avoided. California University 1 reel, rent $1.00.

Tuberculosis. Akin 1 reel, rent $.50. This film deals with the childhood type of tuberculosis, showing the nature of the infection during the early stages, and the prevention of active diseases of Preventorium treatment.

IX. PERSONAL HYGIENE—GENERAL HEALTH

Back to the Sun. Public Welfare Picture 35mm. sound and silent, apply for rental rate. Nudist and nature film, sound and silent versions available, full length feature film, showing physical culture, benefits of nudism, etc.

Bending the Twig. Institutional Cinema Service 1 reel, rent $1.50, sale $24.00; Mogull rent $.50; Edited rent $1.50. Early training in health habits. Cleanliness: how and when to wash and brush the teeth; the best place to sleep; food for growing bodies; when and how to eat; foot freedom. Many familiar health rules are emphasized throughout the film.

Forming the Habits of Health. National Motion Picture Company 1 reel, rent $1.50; sale 16mm. $40.00, 35mm. $100.00. A one reel educational motion picture which shows the importance of habit formation and interestingly reveals the experiences of a girl who sets out to form habits which lead to health.

Gateway to Health. Kent.

General Health Habits. California University 1 reel, rent $1.00; DeVry sale $24.00; Institutional Cinema Service rent $1.50, sale $24.00; Y.M.C.A. rent $1.50; Edited rent $1.50. Modern city life contrasted with simple country life with its abundance of fresh air and sunshine; an excursion into the country; a program for health; a score card to help; results of lack of sunshine; cleanliness.

General Hygiene. New York State 1 reel, free; Edited rent $1.50. Stresses general personal hygiene. Is suitable for high school classes

Good Teeth—Good Health. Wisconsin 1 reel, free.

Healthograms. New York State 35mm., free. A series of six short trailers consisting of interesting events and scenes with health hints. Combined they make a very interesting one reel picture or they can be shown separately. (1) *Take To The Sun*—shows ancient races as the original sun worshippers and crowded beaches of today. The health-giving value of sunlight is now clearly recognized. (2) *See the Fat Lady*—shows circus fat lady and explanations of why overweight is dangerous and how it may be avoided. (3) *Baby Food for All*—milk is the most perfect food, good for young and old. (4) *Why Exercise?* Exercise does more than strengthen muscles. It is a great benefit to general health. (5) *Baby Needs a Check-Up*—Give your baby a fair chance in life. Don't wait for sickness before calling a physician; have examinations regularly. (6) *Your Body Engine*—The human body compared to great engines. A check-up on both is essential for good operation.

He Who Laughs Last. New Jersey Tuberculosis League, free. An appeal for periodic health examination.

How to Live Long and Well. National Motion Picture Company 1 reel, sale 16mm. $40.00, 35mm. $100.00; Pinkney 16mm. sale $23.00, rent $1.50-$2.00; 35mm. sale $65.00 rent $2.50-$3.00. Embodying the consensus of authentic opinion on the correct habits of a sensible, healthy life, presented with the artistic features of an advanced film-craft.

Jinks. National Motion Picture Company 1 reel, sale 15mm. $40.00, 35mm. $100.00. A one reel comic cartoon telling of a sick man's adventures with the enemies of health.

Knowing Gnome, The. Society Visual Education 1 reel, rent $1.50. A story of the wisest and busiest of a family of little men who live high up in the mountains, and whose duty it is to watch over the world's treasures. This little man takes in hand two children, Betty and Bobby, and leads them to happiness by showing them how to take care of their health.

Lessons in Health and Hygiene. Mogull 1 reel, rent $.50. A DeVry teaching film on health habits in general.

Life of a Healthy Child. American Dental Association 1 reel, rent $1.00; Hill sale $21.00; Iowa rent $.35; New York State, free; Nu-Art Filmco sale $28.00. This film illustrates all activities in a normal child's life, stressing periodic medical and dental examinations, correct posture, proper food, right eating, plenty of water, cleanliness, wholesome exercise and carefree play, carefulness, safety first, approved method of caring for the teeth and mouth, fresh air day and night, sunshine, abundant sleep, right thinking, and contented mind.

Physical and Mental Fitness. Edited 1 reel, rent $1.50. Teaches how self-discipline makes for happiness; that physical and mental fitness depends on systematic daily training.

Priceless Gift of Health. New Jersey Tuberculosis League, free. Story of two boys; one with a good start in life through proper nourishment and the other with a handicap.

Taking Punishment. F. C. Pictures 1 reel 35mm., rent $3.00. The need of keeping physically fit to indulge in any sport.

T. C. Your Sixth Sense. California University 1 reel, rent $.50. Value of proper temperature. How the body makes adjustments to maintain normal temperature under varying conditions. Manufacturing thermometers; their different uses.

Working for Dear Life. Metropolitan 1 reel, free; National Safety Council; New York State, free; Y.M.C.A. 1 reel, free. A contrast between man's constant vigilance and inspection of locomotives, automobiles, airplanes and nearly everything else with his total neglect of the inspection of his own body.

Preaches the need for the annual health examination.

X. PERSONAL HYGIENE—MOUTH AND TEETH

About Teeth. Mogull 1 reel, $.50. A lecture on oral hygiene.

Ask Your Dentist. American Dental Association 35mm. and 16mm. 1 reel, rent $1.00; Iowa University rent $35.00; McCrum sale 35mm. $75.00, 16mm. $35.00; A dental hygiene film suitable for either adults or school groups, partly animated. Plaster models are used to show tooth construction.

Betty's Crooked Teeth. American Dental Association 1 reel, rent $1.00; McCrum 16mm. sale $35.00. Betty is taken to the dentist for orthodontic treatment. While there the orthodontist explains with models, x-rays, and drawings, the causes, prevention and correction of crooked teeth.

Bobby's Bad Molar. American Dental Association 1 reel, 35mm. and 16mm. rent $1.00; Iowa University rent $35.00; McCrum sale 35mm. $75.00, 16mm. $35.00; New York State, free. The film presents the facts of Dental Hygiene in a very simple but convincing manner.

Care of the Teeth, The. American Dental Association 1 reel, rent $1.00; Eastman sale $24.00; Iowa University rent $35.00; Wisconsin rent $1.00 includes teaching

guide; Akin rent $.50. A film that records by labeled radiographs, animated drawings, and actual photography, the parts of the tooth, prophylactic treatment, the progress of decay, the effects on the teeth of bad habits and disease, and the rules for systematic home care and brushing of teeth.

Clara Cleans Her Teeth. American Dental Association 1 reel, 35mm. and 16mm. rent $1.00; McCrum sale 35mm. $75.00, 16mm. $35.00; New Jersey Tuberculosis League, free; New York State, free. Clara, aged 10, always neglected her teeth until she learned, through her playmates, the importance of daily brushing and care.

Demon's Downfall. New York State 1 reel, free; Wisconsin, free. Excellent animated cartoon, teaches lessons in dental hygiene.

Don't Wait Until It Hurts. Iowa University 1 reel, rent $.35. This film shows the value of regular visits to the dentist, the difference between the attitude of children who go frequently and those who go only when trouble appears.

Home Care of the Teeth. International Dental Health Foundation.

Home-Run Bill. Hudson County Tuberculosis League, 2 reels, free; Wisconsin, free. This is the story of a boy who corrects his dental defects. Suitable from Grade 3 and up. Showing time 30 minutes.

Mouth Hygiene. Institutional Cinema Service 1 reel, rent $1.50, sale $24.00; Akin rent $.50. The teeth, a chewing machine; tooth decay; condition for multiplying disease germs; cause and progress of tooth decay; nerve of a tooth; abscesses discovered by x-ray; correct way to brush the teeth; use of dental floss; a public school dental infirmary.

Mouth Hygiene for School Children. Dr. Alfred C. Fones, 10 Washington Street, Bridgeport, Connecticut.

Nature Builder of Teeth. American Dental Association 1 reel, sale $25.00.

Nature's Way to Good Teeth. New York State 1 reel, free. A natural science picture showing birds and small animals and incidentally bringing in the value of proper diet for sound teeth.

Oral Prophylaxis. Merrell 1 reel, free. Complete in one reel and shows the proper method of caring for the mouth, teeth, and gums to insure their health and cleanliness.

Pyorrhea. Merrell 1 reel, free. Complete in one reel and gives the technique and medication employed in the treatment of pyorrhea.

Teeth. DeVry 1 reel, sale $24.00; Edited rent $1.50; Institutional Cinema Service rent $1.50; sale $24.00; Iowa rent $1.00; Mogull rent $.50; Y.M.C.A. rent $1.50. The specific aim of this lesson is to inform the pupils on the growth, structure and method of caring for the teeth; the diseases which are liable to occur and their relation to general health; and to encourage the formation of correct habits regarding the care of the teeth.

Teeth—How Teeth Grow. Eastman 1 reel $24.00. The order of formation and eruption of the temporary and permanent teeth is demonstrated by animation, models, and subjects of various ages.

Tiny's Troublesome Tooth; or A Germ, A Tooth and A Joint. Dr. Fred Conboy, 1043 Bloor Street, Toronto, Canada.

Tommy's Troubles. American Dental Association 1 reel 35mm., rent $1.00; Iowa rent $.35; New York State, free; New York Tuberculosis and Health Association sale 35mm. $110.00. Shows the importance of care of the teeth and stresses the value of nutrition in the formation of sound teeth. Humorous.

Tommy Tucker's Tooth. American Dental Association 35mm. and 16mm., rent $1.00. The "Tell a Story Lady" narrates to a group of children the importance of keeping teeth in good condition. Animated films.

Your Mouth. American Dental Association 1 reel 35mm., rent $1.00; Kent 16mm. sale $35.00, 35mm. $100.00; New York State, free. Fundamental requirements for the care of the teeth and prevention of decay.

XI. PERSONAL HYGIENE—POSTURE

Carriage. Gaumont British 1042 ft. 35mm. The correct way of standing, sitting, and walking illustrated by children from elementary schools in a large town.

Feet, The. California University 1 reel, rent $1.00; Eastman sale $24.00; Kansas University rent $1.50; Wisconsin University $1.00 includes teaching guide. Prepared in cooperation with the American Posture League. Shows details of structure and arrangements of the arches; the best mechanical use of the foot; the points of a good shoe, and harmful effect of improper shoes; good feet as an asset.

Posture. DeVry 1 reel, sale $24.00; Eastman sale $24.00; Edited rent $1.50; California University rent $1.00; Iowa rent $1.00; Mogull rent $.50; New York State, free; Akin rent $.50. Prepared in cooperation with the American Posture League. Good posture, both standing and sitting—the part played by muscles in determining whether it shall be good or bad, how to correct poor posture, and the importance of good posture in physical well being.

Posture. California State Department of Health 2 reels, free; 35mm. New Jersey Tuberculosis League, free; United States Department of Labor, free; New York State, free. A film presenting material on good posture and its relation to physical fitness. School children demonstrate good and poor posture and the posture exercises. Animated drawings show the effect of posture on the bony framework of the body. Glimpses of well-known athletes and others are used to illustrate good posture.

Posture. Institutional Cinema Service 1 reel, rent $1.50, sale $24.00. West Point cadets on parade; natural position of the feet when walking; footprints in the sand; fallen arch; exercises to strengthen the muscles of the foot; effects of wearing too narrow shoes; how high heeled shoes throw the body out of natural balance; correct posture; corrective exercises for defects in posture.

Shoes. Twentieth Century Fox 1 reel, sale 16mm. $35.00, 35mm. $75.00.

XII. PERSONAL HYGIENE—SIGHT

Eyesight. DeVry 1 reel, sale $24.00; Edited rent $1.50; Mogull rent $.50; Y.M.C.A. rent $1.50; Akin rent $.50. Shows delicate structure of organ of sight; necessary precautions to protect, safeguard and preserve the eyesight.

Light for Living. General Electric 3 reels, free. A discussion of lighting in the home. It brings out in greater detail the correct standard of lighting and some interesting facts concerning defective eyesight, and demonstrates how adequate lighting can minimize eyestrain.

Point of View, The. F. C. Pictures 1 reel 35mm., rent $3.00. The use and care of the eyes.

Preventing Blindness and Saving Sight. Eastman 2 reels, sale $42.00; National Society for Prevention of Blindness 16mm. or 35mm., free; Wisconsin rent $2.00; Akin rent $1.00. The film shows vision defects and their correction; eye diseases, notably trachoma, and their prevention; rules for eye health through proper illumination, eye care and preventive measures in childhood and old age, and industrial eye protection.

XIII. PERSONAL HYGIENE—SUNSHINE

How We Keep Warm. Twentieth Century Fox 1 reel, sale 16mm. $25.00, 35mm. $75.00.

Land of Sunshine. Modern Woodmen of America 1 reel sound-on-film, free.

Sunshine. Iowa 1 reel, rent $1.00; Y.M.C.A. rent $1.00. This film by many different demonstrations shows the great necessity of sunshine to man as well as all types of living animal and plant life.

Way to Strength and Beauty. Public Welfare Picture 35mm., free. Physical culture films, available in five reel silent version only with some notes on nudism.

XIV. PERSONAL HYGIENE—WEIGHT

Fat Chance, A. New York State 1 reel, free. Dangers of overweight and methods of reducing.

Too Many Pounds. F. C. Pictures 1 reel 35mm., rent $3.00; New York State, free; Y.M.C.A., free. Film on overweight and sensible methods of prevention. Illustrates the fact that modern comforts and ways of living have brought us to a lack of exercise and consequent overweight. An amusing picture.

XV. SAFETY

Ask Daddy. National Safety Council 2 reels 35mm., rent $5.00 to members, $10.00 to non-members. Deals with home and street safety and firearms.

Automobile Safety. Wholesome 1 reel 35mm., rent $3.00. Shows how accidents are caused by careless drivers and ways and means of avoiding accidents.

Bad Master, The. Aetna 1 reel 16mm. and 35mm., both sound and silent, free; Akin rent $.50. Fire prevention film that portrays the dangers that result from careless use of fire and shows the care that should be taken to prevent fire.

Blue Flag, The. Pullman Company, Pullman, Illinois, 1 reel 35mm., rent $2.50. Graphically depicts hazards to workers in railroad yards and the successful use of the "blue flag."

Brush Fire, The. United States Department of Agriculture 1 reel, free. Technical instruction in brush burning designed to protect the woods from damage through carelessness.

Carbon Monoxide. New York State 1 reel, free. Warns of danger of inhaling deadly gas which is colorless, odorless, and tasteless. It shows how it may be encountered in workshop, garage or home and gives methods of counteracting this hazard.

Carbon Monoxide: The Unseen Danger. American Museum Natural History 1 reel, free; United States Bureau of Mines, free. Shows dangers of carbon monoxide gas from an automobile running in a closed garage and proper First Aid methods to be used in resuscitation.

Coney Island—Safety and Health at the Beach. American Museum Natural History 1 reel, free. The film shows thoughtless killjoys who do not keep the beach safe, clean, and orderly. Six hundred dollars is expended every day because of such pests.

Cross-Road Puzzle, The. American Automobile Association, Hotel Pennsylvania, New York City, 2 reels 35mm. and 16mm., rent $10.00. A semi-humorous picture showing an elderly couple and the troubles they meet in traffic on a silver anniversary trip from California to Niagara Falls. Produced with the idea of pointing out the serious conditions confronting the nation through a multiplicity of traffic regulations and with the hope of stimulating national interest in uniformity of traffic rules.

Dangerous Dusts. United States Department of Agriculture 1 reel, free. Shows the effects of some of the most damaging dust explosions on record and stirring scenes of resulting fires; also how such explosions take place; outlines preventive measures.

Death Takes No Holiday. National Bureau of Casualty and Surety Underwriters, free. A talking slide film dealing with motor traffic safety. Emphasizes the constructive "What can I do" aspect.

Enemy of the Forest. American Museum Natural History 1 reel, free. An educational fire-prevention picture showing the evils of carelessness in the woods, the disastrous results therefrom, and steps taken toward fire protection in forests.

Everybody's Business—A Plea for Safer Driving. National Safety Council 16mm. and 35mm., both in silent and sound, rent $5.00. Beginning with its challenge

and plea for the public's cooperation with the police, who are striving to make traffic safer, the film achieves a place as constructive entertainment. This picture arraigns the driving blunders and violations of traffic regulations which precipitate accidents.

Farther, Faster, Safer. Y.M.C.A. 3 reels sound, free. A United States history of transportation development.

Fire Prevention. Eastman 1 reel, sale $24.00; Wisconsin rent $1.00 includes teaching guide. Fire resisting construction; electrical insulation; safeguarding inflammable materials. This film is designed to show typical precautions for fire prevention.

Fire Protection. California University 1 reel, rent $1.00; Eastman sale $24.00; Wisconsin University rent $1.00 includes teaching guide. Fire extinguishers; the fire department in action; the training of firemen; fire safety. The purpose of this film is to demonstrate scientific principles relative to extinguishing fires.

Fire Safety. California University 1 reel, rent $1.00; Wisconsin rent $1.00 includes teaching guide; Akin rent $.50. Fire losses; preventing fires; what to do in case of fire; fire prevention by school children.

Forest and Health. California University 1 reel, rent $.30. How the forest ministers to the spiritual and physical health of mankind.

Forest Fire. California University 1 reel, rent $.30. Putting out small fires; fighting big fire, showing the hiring of fighters, packing their supplies, digging trenches, felling trees, bringing up water from streams with portable pumps. Air patrol locating fires and dropping messages to fighters.

Forest Fires or Game? California University 1 reel sound, rent $1.00, silent $.30. Of interest to those who use our forests for recreation.

Formations, and the Other Fellow. Chevrolet 1 reel 35mm. sound shown in three offices without cost.

Four Wheel Brakes. Y.M.C.A. 1 reel, rent $1.50. They fail to hold when a street car conductor, in a roadster, meets disaster at a crossing.

Friends of Man. United States Department of Agriculture 4 reels, free. A story picture designed to discourage the practice of "burning off." Includes spectacular scenes of forest fires.

Gambling With Death. New York Central Lines, New York City, 1 reel 35mm., rent $2.50. This picture shows the highway-railroad grade crossing situation from every angle, the principal causes of accidents being portrayed by actual occurrences.

Goofs. Automobile Club of Southern California free, 1 reel 35mm.; sale out of state 16mm. $25.00, 35mm. $50.00. This picture presents a series of automobile accidents which have actually occurred. It is very realistic and brings home lessons that are not forgotten.

Handicap, The. National Safety Council 1 reel 35mm., rent $2.50 to members, $5.00 to non-members. A romantic story teaching an impressive safety lesson.

Highlights of the Science of Seeing. General Electric 2 reels, free. An instructive discourse demonstrating the safe standard of lighting for every room in the home. This film for the general public ties in with the "Better Light—Better Sight" campaign.

Highway Mania. Commission of Motor Vehicles, Trenton, New Jersey, 2 reels 35mm., sound free. A description of the highway maniac. Improper and proper practices are shown.

Hindsight Versus Foresight. National Safety Council 2 reels 35mm., rent $5.00 to members, $10.00 to non-members. This film portrays the daily lives of a manager or owner, a foreman, and workmen of an industrial plant. Some methods of combating hazardous conditions are shown in foundry scenes emphasizing the need of safety.

Hit and Run Driver, The. 1 reel 35mm. on sound, Metro-Goldwyn-Mayer Corpo-

ration (Recommended by National Safety Council). One of "Crime Does Not Pay" series showing detection, conviction, and remorse of young hit and run driver.

Hit That Scored, The. National Safety Council 1 reel 35mm. A good-natured but reckless truck driver believes in bluffing the other fellow, until an accident, which almost causes the death of a little girl, teaches him the lesson of safe driving.

Horse Sense in Horse Power. National Safety Council 16mm. and 35mm., both sound and silent. Dramatizes need for careful driving. Packed with enough hair-raising thrills to jar even the most callous of "Public enemy" drivers; it creates nation-wide attention on the need for more careful driving.

How Jimmy Won the Game. Institute of Makers of Explosives, 103 Park Ave., New York City, 1 reel 35mm., rent $2.50. Jimmy learns about the dangers of blasting caps from his father, a quarry boss. He later has a striking chance to put the knowledge to work and thus prevent a tragedy to the star pitcher of the home baseball team.

Inertia and the Other Fellow. National Safety Council (Obtained from the State Adjutant, American Legion), talking slide film, free. Forceful and compelling arraignment of the accident problem containing powerful lessons for individuals and communities alike.

It Might Have Been You. Wisconsin 1 reel $.50. Portrays a disastrous forest fire and shows what the Forest Service is doing to prevent such a catastrophe.

Men and Machines. Lumberman's Mutual Casualty Company, Chicago, 2 reels 35mm., free. (National Safety Council recommendation.) The story swings into industry's wide range of activities, with man's well-being as the main theme.

Making of a Safe Miner, The. American Museum Natural History 2 reels, free; United States Bureau of Mines, free. The story of a capable, but careless miner who becomes converted to carefulness and safety observance through personal experience with first aid following an accident in a bituminous coal mine.

Once Upon a Time. Metropolitan Life Insurance Company 1 reel in technicolor or black and white on 16mm. or 35mm., free; New York State, free; Y.M.C.A. sound, free. This picture is an animated cartoon with musical symphonies (on the sound film) and shows a fairy-land setting used to emphasize the need of safety on the streets. Two Goblins "Carelessness" and "Discourtesy" plot to cause well known characters of childhood to become involved in present-day types of street and highway accidents.

Only Way, The. F. C. Pictures 1 reel 35mm., rent $3.00. A plea for safe methods of accident prevention.

Outlaw, The. Liberty Mutual Insurance Company, Boston, Mass., 2 reels 16mm. and 35mm., rent $10.00. "King Carelessness" smuggles a troupe of mischievous imps into a factory. "Take-a-Chance," "I Should Worry," "Never Mind," "Don't Think," "Horseplay," "Inattention," etc., prompt workmen to do foolish, dangerous things. They are successful for a while but the factory manager, safety engineer, and the workmen gain control.

Public Enemy No. 1. Commission of Motor Vehicles, State of New Jersey, Trenton, New Jersey, recommended by National Safety Council 2 reels 35mm., free. Depicting traffic hazards. Based upon actual cases taken from the records of the New Jersey Department of Motor Vehicles. Action "shots" of collisions, skids, and other all too common highway accidents.

Readin' Ritin' an' 'Rithmetic. American Museum Natural History 1 reel, free; American Electric Railway Association, 292 Madison Avenue, New York City 1 reel 35mm. and 16mm., rent $1.00; Y.M.C.A., free. A safety film for elementary grades in which a teacher instructs her class in safety measures in boarding street cars, buses, crossing streets, playing, etc.

Reason Why, The. United States Steel Corporation, 71 Broadway, New York City. (Recommended by National Safety Council) 2 reels 35mm., free. Illustrates the many hazards of industry, showing the right and wrong ways of performing duties, as well as safeguards for various machines.

Red Robber, The. Pyrene 2 reels 35mm. or 16mm., free, recommended by the National Safety Council; Akin rent $1.00. Demonstrates the use of various fire fighting equipment as it relates to farm fire prevention.

Remember Jimmy. American Museum Natural History 1 reel, free; Fireman's Fund, free. An excellent safety film showing the disastrous results of speeding, inattentive and drunken driving, cutting in, etc.

Safe Automobile. Mogull 1 reel sound, rent $1.00. A series of exciting auto driving incidents in the thick of traffic in the city.

Safety Pays. New York Central Lines, New York City (Recommended by the National Safety Council) 2 reels 35mm., rent $5.00 to Council members and $10.00 to non-members. A film for railroad transportation department employees and shop employees.

Safety Wins. Y.M.C.A. 2 reels, free. An industrial safety romance.

Saving Seconds. Aetna 2 reels free both widths sound and silent; American Museum Natural History 2 reels, free; Wisconsin, free; Y.M.C.A. 2 reels, free; Akin rent $1.00. The purpose of this picture is to prove the folly of attempting to save seconds at the possible sacrifice of human lives.

Sounding the Alarm. Aetna 1 reel, free. Fire film that shows the various means of reporting a fire, the fire department in action and the great dangers caused by false alarms!

Spills and Thrills. Garrison 1 reel sound-on-film, rent $1.50, sale $30.00. Action picture of the speed demons of the air, turf, and surf. Shows the accidents that come with recklessness. Very useful subject for public safety campaigns.

Street and Highway Safety. New York Police Academy, free. One of the best pictures for elementary schools. Prepared by the New York Police Department and recommended by the National Bureau of Casualty and Surety Underwriters.

Street Safety—For Advanced Grades. Eastman 1 reel, sale $24.00; Iowa University 1 reel, rent $1.00. Illustrates fundamental safety principles designed to govern outdoor activities of older children or adults. Both this film and the half-reel for primary grades were made in cooperation with the National Safety Council and the American Automobile Association.

Street Safety—For Primary Grades. Eastman ½ reel, sale $12.00; Iowa University rent $.75. A trained police dog is included among the actors and is used to demonstrate cardinal points in street safety by the indirect methods. This half-reel subject is designed especially to impress younger children.

Take It Easy. Y.M.C.A. 3 reels sound, free. A highway safety message.

That Brush Fire. California University 1 reel, rent $.30. Technical instruction in brush burning designed to protect the woods from damage through carelessness.

Truck and the Driver, The. Aetna 1 reel, free. Safety film that depicts the highway problem from the standpoint of the truck driver, and portrays the right and wrong practices, the methods of maintenance, and road courtesies in driving a truck.

Twelve Points of Safety. United States Bureau of Mines 1 reel 35mm., free. Stresses some important safety measures in connection with daily operation of mines. Of special interest to managers and supervisors.

Verdict, The. National Safety Council 2 reels 35mm. and 16mm., rent $5.00 to Council members, $10.00 to non-members. A story depicting the speeder, the jaywalker, the lady driver who doesn't believe in signs, the truckman who thinks that "kids" ought to stay out of the street, and the man who has had "only a couple of drinks."

We Drivers. General Motors Corporation, Detroit, Michigan (Recommended by

the National Safety Council) 1 reel 35mm. and 16mm., sound and silent, free. Shows the common hazards of the road and depicts safe and unsafe practices for passing on hills, curves, etc.

Why. United States Steel Corporation, 71 Broadway, New York City, 2 reels 35mm., free; Y.M.C.A., free. Accident causes and prevention. Educating the workers; safety devices explained to new men; safety meetings; safe and unsafe practices; danger of practical joking.

Why Be A Goose? Automobile Club of Southern California 1 reel, free in state, sale 16mm. $25.00, 35mm. $50.00. The picture depicts a series of episodes based upon traffic accidents which have actually occurred. It is best adapted to elementary school use.

Why Be Careless? John Hancock 1 reel 35mm. or 16mm., free. This film is designed to prevent highway accidents. The common causes of such accidents are illustrated.

XVI. FIRST AID

Artificial Respiration. Loucks and Norling 1 reel 35mm., rent $2.50, sale $100.00; New York State, free. This film shows in practical fashion how to revive persons from drowning and from asphyxiation by gas and electric shock. Also, diagrammatically portrays what takes place in the human system when the prone pressure method is applied.

Before the Doctor Comes. Society Visual Education 1 reel, rent $1.50. First aid in coal mines, steel mills and railroad yards, machine shops, lumber camps, and other places where accidents occur daily, and where a doctor's services are not always immediately available.

Every Swimmer a Life Saver. Society Visual Education 1 reel, rent $1.50. Shows the most approved and latest methods of rescue and resuscitation, including first aid methods as practiced by Boy Scouts.

First Aid—Care of Minor Wounds. Eastman ¼ reel, $6.00; Wisconsin rent $.50 includes teaching guide. Stresses the importance of immediate care for even the slightest wound. Demonstrates proper method of applying sterile dressings.

First Aid—Carrying the Injured. Eastman ¼ reel, sale $6.00; Wisconsin ¼ reel, rent $.50 includes teaching guide. Demonstrates the making and using of stretchers in emergencies, and the methods of carrying injured persons without stretchers.

First Aid—Control of Bleeding. California University 1 reel, rent $.75; Eastman ¾ reel, sale $18.00; Kansas University rent $1.50; Wisconsin $1.00 plus teaching guide. Shows, with actual photography and animated diagrams, accepted methods of control of arterial and venous hemorrhages.

First Aid—Life Saving and Resuscitation. California University 1 reel, rent $1.00; Eastman sale $24.00; Wisconsin rent $1.00 includes teaching guide. Demonstrations in water and (in slow motion photography) out of water, of various approaches and holds used in rescuing the endangered swimmer. Methods of resuscitation shown include use of the inhalator.

Learn and Live. United States Bureau of Mines 1 reel 35mm. and 16mm., free. A story picturing the value of first aid and demonstrating the Prone Pressure Method of Resuscitation.

Life Saving. F. C. Pictures 1 reel 35mm., rent $3.00; Gaumont British rent; Mogull rent $.50. Instruction in the latest technique.

XVII. SOCIAL HYGIENE

Birth. Public Welfare Pictures 6 reels 35mm. sound and silent. A motion picture which has to do with maternity. This film was made in Switzerland. It shows

by comparison the modern scientific methods of childbirth as compared with the old antiquated methods of the mid-wife. It contains the story and dangers of abortion as practiced by non-professionals.

Clinical Reels. Public Welfare Pictures 35mm. sound and silent. Actual clinical cases showing diseases of the male and female. (Venereal.)

Damaged Lives. Capital Film Exchange Incorporated, 6 reels accompanied by a three reel profuse lecture. Rental not given. Deals with the story of syphilis.

Darkfield Diagnosis of Primary Syphilis. American Social Hygiene Association 1 reel, rent $1.00, sale $25.00. Photographs of primary lesions, or chancres, diagrams showing formation of primary lesions, use of darkfield microscope, technique of taking specimens for diagnosis.

Deferred Payment. American Social Hygiene Association 4 reels, rent $4.00, sale 16mm. $140.00, 35mm. $200.00. A young seaman after becoming infected with syphilis, marries and infects his wife. Through their ignorance of the seriousness of the disease and means of prevention, one of their children is congenitally syphilitic and has impaired eyesight. The other, proper pre-natal treatment having been given, is healthy and sound. Adults and young people only.

False Shame. Public Welfare Pictures 4 reels. Deals with actual cases on social hygiene.

Female Reel. Public Welfare Pictures. Shows diseases in the female body and organs.

For All Our Sakes. New York State talking slide film, free. A popular presentation of the public health aspect of syphilis; suitable for adults and adolescents.

Gift of Life, The. American Social Hygiene Association 4 reels, rent $4.00, sale 16mm. $108.00, 35mm. $170.00; New York State, free. See "Parent Education." Under guidance of a scientist, a boy makes field observations, collects specimens and sees through the microscope the processes of reproduction in lower forms of plant and animal life. Continuing to higher life forms eggs are incubated and life and movement of the embryo shown at different periods. Animated diagrams make clear processes that cannot be photographed, and with logical sequence and easy transition the study progresses to mammals and human beings. In summary, with an apt comparison of embryos, the principles of reproduction are reviewed and shown to be the same as in other mammals. For adults and young people.

Gonorrhea in the Male, Diagnostic and Treatment Technique. American Social Hygiene Association 3 reels, rent $3.00, sale 16mm. $75.00, 35mm. $115.00. For physicians and medical students.

Male Reel. Public Welfare Pictures 1 reel 35mm. sound and silent. Complete one reel subject showing actual photographs and diagrams of venereal diseases in the male.

Modern Diagnosis and Treatment of Syphilis. American Social Hygiene Association 3 reels, rent $3.00, sale 16mm. $75.00, 35mm. $115.00. For physicians and medical students.

Mysteries of Sex. Public Welfare Pictures 1 reel 35mm., sound and silent. Feature length sound picture dealing with medical students. Film shows actual change of sex operation, natural birth, autopsies, care of infants.

Naked Truth, The. Public Welfare Pictures 35mm. sound and silent. This is a full length feature film, showing the dangers of promiscuous sex relations; deals with prostitution and venereal disease.

Science of Life, The. (Series). Bray each reel, rent $2.00, sale $35.00.

Section III, Personal Hygiene. Reel X: *Personal Hygiene for Young Women.* Reproduction and important allied subjects carefully yet comprehensively treated; relation to health and character of internal secretions; wholesome treatment and thinking; wise eating and care in selection of companions, for health and happiness.

Reel XI: *Personal Hygiene for Young Men.* Internal secretions and their rela-

tion to health and power; reproduction and important allied subjects; dangers of indifference to self control.

Reel XII: *General Personal Hygiene.* This reel with the two preceding ones rounds out a clean-cut, wholesome, and inspiring presentation of fundamental information as a safeguard to health. Standards of health promotion; exercise; good air; sunshine; sleep; cleanliness; footwear; care of teeth, eyes, hair; mental health; heredity.

Prenatal Care. United States Department of Labor 1 reel, free. The purpose of the film is to emphasize to the expectant mother the necessity of adequate prenatal care.

Reproduction in Higher Forms of Life. California University 1 reel, rent $1.50; Bray rent $2.00, sale $35.00. Development of higher organisms from the one celled stage; reproduction in fish, reptiles, birds and mammalia, including ovulation, fertilization, development and nourishment of the embryo.

Science and Modern Medicine. American Social Hygiene Association 3 reels, rent $6.00, sale 16mm. $75.00, 35mm. $145.00; New York State, free. A new and up to date lecture on the nature of the diseases, syphilis and gonorrhea, the need for early competent treatment, the effects of the diseases when untreated, the possibilities of cure with proper treatment. The process of reproduction is also described. Text is available in pamphlet form. For adults and young girls.

Social Hygiene for Women. American Social Hygiene Association 2 reels, rent $2.00, sale 16mm. $60.00, 35mm. $95.00. Clearly, but with care and good taste throughout, it explains the anatomy and functions of the sex organs, fertilization, cell division, development of the embryo (carried to the fully formed child), role of the placenta (dispelling the popular fallacy of "maternal impressions"), and the essential facts regarding the venereal diseases. A minimum of clinical cases is shown. For women and older girls (lay groups).

Two Family Stork, The. New York State 1 reel, free. Contrasting the preparations made by the Wise Family and the Thoughtless Family for the advent of the new baby.

Venereal Diseases. American Social Hygiene Association 3 reels, rent $3.00, sale 16mm. $75.00, 35mm. $115.00. Animated diagrams show anatomy of the male and female reproductive organs and their physiological processes. Photographs of actual cases are shown arranged in the order generally followed by experienced lecturers. This film is designed to illustrate lectures to older boys and men on sex hygiene and prevention of venereal diseases.

XVIII. PARENT EDUCATION

Best Fed Baby, The. Iowa University 1 reel, rent $.35. This can be shown only to adults. It insists that all mothers can nurse their babies, thus giving them a four to one chance for life, and tells how the mother's supply of milk can be restored and maintained.

Care of the Feet, The. Coward 1 reel, free in New York.

Dissection of the Foot, The. Coward 1 reel, free to doctors and nurses, etc., in New York City.

Doctor Decides, The. New Jersey Tuberculosis League, free. Medical audiences. Doctor is central figure and the story of tuberculosis is told from his standpoint.

Gift of Life, The. United States Public Health Service 4 reels, free. See "Social Hygiene."

How Life Begins. United States Public Health Service 3 reels, free.

Perils of Motherhood. Public Welfare Pictures 35mm. sound and silent 3 reels. Three reel sound featurette, also called "Duties of Motherhood" dealing with facts every expectant mother should know. Films show actual birth and Caesarian operation and care of newly born babies.

Priceless Gift of Health, The. National Motion Picture Company 1 reel, sale 16mm. $40.00, 35mm. $100.00. An enjoyable educational motion picture, showing that the health of the child should be guarded at every step from infancy to maturity and presenting in a pleasing manner an instructive guide to conduct for thoughtful mothers.

Proper Posture. Coward 1 reel, free in New York City.

Science of Life, The. United States Public Health Service 12 reels, free.

Reel I: Protoplasm. The Beginning of Life.
Reel II: Reproduction in Lower Forms of Life.
Reel III: Reproduction in Higher Forms.
Reel IV: Interdependence of Living Things.
Reel V: How Plants and Animals Cause Disease.
Reel VI: How Disease is Spread.
Reel VII: How To Prevent Disease.
Reel VIII: How the Mosquito Spreads Disease.
Reel IX: The Fly as a Disease Carrier.
Reel X: Personal Hygiene for Young Women.
Reel XI: Personal Hygiene for Young Men.
Reel XII: General Hygiene.

Social Hygiene for Women. United States Public Health Service 2 reels lecture film, free.

Standard Obstetrical Routine. Mennen 6 reels, free. This is a silent film depicting an entire delivery of a child from the moment the mother is admitted to the hospital to the time she and her baby are discharged. The picture was prepared for hospitals, colleges, etc., for showing to their nurses, classes, students, staff doctors, etc.

Sun Babies. California State Department of Health 1 reel, free; Iowa rent $.35. This is for use with mothers of young children. Rickets—the cause and cure. It shows the value of sunlight and cod-liver oil. Advocating exposure to the sun for babies and older children in both winter and summer.

Take No Chances. New Jersey Tuberculosis League 1 reel, free. A state sanatorium picture—the success of its treatment. It is designed to overcome the dread of institutions and is a message of hope and cheer.

Venereal Diseases, The. United States Public Health Service 2 reels lecture film, free. Lecture film for men.

PHYSICAL EDUCATIÓN FILMS

I. ARCHERY

Archery. Craft Archery Co., 9191 E. Pine St., Tulsa, Okla. "Film has shots of arm and hand position with and without bow. Titles could be shortened. No slow motion analysis or clear close-ups. Revision suggested."[2]

Last Wilderness. Capital 30 minutes. Featuring Howard Hill, champion archer of the world.

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[2] All quotations used in the remainder of this report are from "Motion Picture Sports for Women," *Journal of Health and Physical Education*, June 1937. This article summarized the work of the Motion Picture Committee, National Section on Women's Athletics. A catalogue of 764 films was sent to eight outstanding women in the field of health and physical education and they were asked to make a blind rating of the films from the information given in the catalogue. 45 films rated unanimously 1 or 2 (1 shows clear evidence of worth and 2 those that may have value but difficult to tell by their description). These 45 films were viewed by a selected group and their criticisms are the ones quoted here.

II. ATHLETICS (GENERAL FILMS)

Actions, Antics, and Acrobatics. Mogull 1 reel, rent $.50. Stunts, action shots.

Analysis of Motion. Burton Holmes 1 reel, rent $1.50. 3,200 pictures per second reveal in slow motion the intricate controlled grace of a pigeon's flight, of diving, high jumping, lariat throwing, hurdling, and baseball pitching.

Ball and Bat or Bat and Ball. Edited ½ reel $.75; Mogull rent $.50; Y.M.C.A. rent $1.00. Lively picture showing different games in which a ball is the factor—tennis, baseball, football, hockey, polo, etc. Many stars of the games are shown in action. "Selected actions from various games played with a ball and bat: handball, golf, baseball, cricket, tennis, hurdling, and polo. Former prominent players in action. Interest value as historical survey, and birdseye view of sports which are national pastimes. Titles and newsreel clips out of date."

Boys. Gaumont British 825 ft. 35mm. The first of a series based on the Board of Education syllabus of Physical Training for Schools, 1933. The class shown consists of boys (aged 10) taken from a congested area in a big city.

Children Aged 4–6. Gaumont British 1175 ft., 35mm. sound 1 reel. Today grown-ups delight in finding new and more engaging pastimes for tiny tots who are too young to join in the established games of the older children. New games, new jolly little five minute variations of hop, skip, and a jump are all shown in this film.

Children Aged 7. Gaumont British 1 reel 35mm. This film shows a typical lesson with the top class of children in an infant school.

Close Figuring. Kodascope 317 ft., rent $1.25. A subject which clearly shows the necessity of close figuring by those who earn their livelihoods in dangerous occupations. The aerial gymnasts, the whip slashing artist, the falling artists must time their acts to a split second. A very interesting picture taken in part in slow motion will interest audiences of all ages.

Clowning the Game. Mogull 1 reel sound, rent $1.00. A Grantland Rice Sportlight—tobogganing, baseball, diving.

Cradle of Champions, The. Kodascope 291 ft. on reel with Lake Mohonk rent $1.25. The youth of today are laying the foundation in their athletic sports for the champion baseball and football players of the future. The lure of sport is the desire of mankind to live in the great outdoors.

Denver Playgrounds. Akin ¼ reel, rent $.25. Activities during the summer of 1936 at several playgrounds showing athletic sports, handcraft, and special ring and bar gymnastics.

Feminine Fitness. Y.M.C.A. 1 reel, rent $1.00; Mogull rent $.50 sound rent $1.00. How women keep themselves well trained in sports. Wellesley College students at basketball, baseball, and other sports.

Feminine Flashes in the World of Sport. Nu-Art Filmco 1 reel, sale $31.50.

Form. Wholesome 1 reel 35mm. rent. "Former champions show form in swimming, diving, golf, tennis, and high jump. Slight value for elementary school where wish to encourage children to do a thing well. Historical records of champions."

Fun. Mogull 1 reel, rent $.50; Willoughby rent $.50. Grantland Rice picture.

Girls. Gaumont British 2 reels 35mm. Based on the Board of Education Manual for schools, 1933. The class shown consists of girls of 11 years of age, from a city elementary school.

Girls' Winter and Summer Games. Gaumont British 1 reel. Includes games such as, Field Hand Ball, Rounders, Stoolball, etc.

Girl Who Found Herself, The. Y.M.C.A. 1 reel, free. A story of a girl who acquired self-control through athletic activities.

Grantland Rice Sportlights. Garrison 1 reel, sale each $30.00.

Coaching Grapplers	Hunting Thrills	Take Your Pick
Flying Leather	Manhattan Mariners	Tennis Topnotchers
Pigskin Progress	Olympic Talent	Timing

Diamond Experts
Battling Silver Kings
Tigers of the Deep
Hook Line and Melody
Angles of Angling
Crystal Champions
Floating Fun
Swim or Sink
Water Bugs
Outboard Stunting
Pack and Saddle
Poise
Riders of Riley
Rough and Tumble
Ski Pilots
Slim Figuring
Speed Limits
Sport Almanac
Younger Days
Blue Grass Kings
Canine Champions
Uncrowned Champions
Ducks and Drakes
Bob White
Par and Double Par
Let 'er Buck

Greatest Game of the Century. Nu-Art Filmco 2 reels $60.00.

Marvels of Motion. Mogull ¼ reel, rent $.50. Tennis, Bronco Busting, etc.

Muscle Building. Akin ¼ reel, rent $.25. Grantland Rice illustrates the best methods of developing good muscles.

Pigeons in Flight, Diving, High Jumping, Lariat Throwing, Hurdling and Baseball Pitching. Burton Holmes 300 ft., sale $15.00. Three ultra slow motion studies each 100 feet in length photographed at the enormous speed of 3,200 frames per second. Movement reduced two hundred times.

Poise. Gutlohn 1 reel, rent $2.00. The importance of poise and balance in sports.

Progressive Training in "Ball Handling" Games. Gaumont British 35mm. 1 reel. Classes of boys and girls from the ages of 4 to 14 years illustrating some of the progressive practices and games which lead to skill in handling a ball.

Rough and Tumble. Bass 1 reel sound, rent $1.25; Gutlohn rent $2.00; Mogull 1 reel sound, rent $1.00; Y.M.C.A. sound, rent $1.25. A Grantland Rice Sportlight explaining the high lights of wrestling, hockey, football, and water polo.

Rural School. Gaumont British 35mm. 1 reel. A typical twenty-minute lesson taken with boys and girls of the middle group (standards 2, 3, and 4) of a three teacher village school.

Slim Figuring. Gutlohn 1 reel, rent $2.00. Women's athletics.

Somewhere Out. Mogull 1 reel, rent $.50. Canoeing, baseball, horse racing, fishing.

South Sea Sagas. Kodascope 1 reel, rent $1.00. A visit to Hawaii.

Spartan Diet. Kodascope 1 reel, rent $1.25. Modern Spartans are seen here indulging in rigorous pastimes. The subject opens with a class receiving boxing instructions, after which we see Jiu Jitsu demonstrated by Japanese; a fast game of soccer played by two teams of Hawaiian girls; and some football plays between the Army and Notre Dame teams analyzed. These are followed by scenes at a rodeo of broncho riding, bull-dogging, and riding steers. Normal and slow motion pictures afford an opportunity to study the action of these hardly sportsmen.

Sport Almanac. Bass 1 reel sound, rent $1.25; Gutlohn rent $2.00; Mogull 1 reel, rent $.50; Willoughby rent $.50. Around the Sport Calendar with Grantland Rice. Action shots of tobogganing, dog sled racing, hockey, baseball, tennis, swimming, football, fox hunting, fishing.

Sport Calendar. Mogull 1 reel $.50. Different sport events well illustrated.

Sporting Brothers. Mogull 1 reel, rent $.50; Y.M.C.A., rent $1.00. Soccer, football and rugby. Grantland Rice Sportlight.

Sports—Summer and Winter. Mogull 1 reel $.50. Speedboat driving, swimming, aeroplaning, ski games, fishing, skiing, tobogganing, ice skating, ice hockey, etc.

Summer Playing Field Activities. Gaumont British 35mm. 1 reel. Illustrates summer activities taken on a playing field with boys 10 years of age. Various games and practices leading up to athletics. Cricket and football are shown. Intensive practice for all, and slow motion of correct methods are important features.

Timing. Gutlohn 1 reel, rent $2.00. The importance of timing in various sports.

Uncrowned Champions. Gutlohn 1 reel, rent $2.00. The best of the amateurs in various sports.

Winning Patterns. Mogull 1 reel sound, rent $1.00; Y.M.C.A. sound, rent $1.25. A study of the winning form of famous athletes in golf, diving, pole vaulting, tennis, and sprinting.

Younger Days. Gutlohn 1 reel, rent $2.00. Sports of the youngsters.

Youth. Akin 1 reel, rent $.50. Grantland Rice Sportlight illustrating the fun in outdoor exercise. Small children play with balls and quoits; older boys on stilts; building and flying model airplanes; at the track meet; children playing tennis; Junior taking muscle building exercise; the young Striblings going through their paces with their famous Dad.

III. BASEBALL

Baseball. Edited ½ reel, $1.50 rent; Akin rent $.50. How Babe Ruth knocks a home run, shown in the course of an exciting game, by the aid of slow motion pictures.

Baseball Form. Mogull ¼ reel, rent $.50. Interesting.

Baseball for the Fan and Players. Garrison 5 reels sound-on-film, sale $30.00 per reel. A series of popular instructional films featuring Lefty Grove and the leading diamond stars giving the "inside dope" on America's National sport.
I: Pitching Form.
II: Batteries for Today's Game
III: Slugging.
IV: Infielding.
V: Outfielding.

Baseball—How Babe Ruth Knocks a Home Run. Kodascope 1 reel, rent $1.25. Showing a number of familiar scenes of a modern baseball game. Underhand versus overhand style of pitching shown in normal speed and analyzed by the slow motion camera. Babe Ruth is the star performer, and is shown knocking a home run. Other well known players are also featured.

Diamond Experts. Gutlohn 1 reel, rent $2.00. Champions of baseball in action.

Heads Up Baseball. Fisher Body 3 or 6 reels, 16mm. and 35mm. sound, free. Views of the 1936 world series in New York, a group of plays illustrating many misunderstood rules of the game, demonstrations of the scientific aspects of pitching, catching, fielding, batting, and base-running.

Hits, Runs, 'n Errors. Pictorial sound, rent $2.00, sale $25.00. A film illustrating how each man plays his position, equipment, techniques of hitting, bunting, base-running, sliding, stealing, and fielding. The P's and Q's of baseball from the most simple facts to the more skillful points of timing and rhythm. All these pointers are illustrated by the Fordham University Varsity under the coaching of Jack Coffey.

How Do You Get Your Exercise? Kodascope 1 reel, rent $1.25. Baseball is described as the principal sport for men up to 20 or 25 years of age. Several games are illustrated, including one between West Point and Annapolis. Then come some examples of gymnastic exercises of the more advanced type, a few scenes of ladies' baseball team, and finally, a series of drills by firemen in laying and connecting hose, climbing walls with a rope and scaling ladder and especially quick work in directing and climbing the ordinary hook and ladder.

Inside Baseball. Bell and Howell 1 reel, rent $1.50.

Major League Baseball Stars in Action. Capital 9 minutes. Infielding, batters of today's game, pitching to form, slugging, first base play, and outfielding.

Open Trails. Kodascope 1 reel, rent $1.25. Introducing our national game of baseball and showing its tremendous appeal to vast multitudes. Babe Ruth is shown at the bat and making a home run. The reporters are shown transmitting the news over wires to 100 cities, while thousands of spectators applaud from the grandstand.

Pitching Form. Mogull 1 reel, sound $1.00. Featuring Robert Grove, shown in pitching, batting, and a regular game, in a number of interesting slow motion shots.

Play Ball. Fisher Body 3 or 7 reels, 16mm. or 35mm. sound, free. Produced by the American League Professional Baseball Clubs. Records the science of the game, and is actually an "animated text book" to quote the word of Judge Kenesaw Mountain Landis, "czar" of baseball.

Take Me Out To The Ball Game. Fisher Body 16mm. and 36mm. sound film, free.

World Series, 1936. Mogull ½ reel, rent $.50. The familiar scenes of the baseball diamond.

IV. BASKETBALL

Basketball. American Olympic Committee 1 reel, rent $4.00. Official Olympic Film 1936.

Basketball. California University 2 reels, rent $2.00; Akin rent $1.00. Early days of basketball, technique of individual and team offense and defense.

Modern Basketball Fundamentals. Eastman 2 reels, sale $48.00; Iowa rent $2.00; Wisconsin 2 reels, rent $2.00. Designed to help coaches in developing successful basketball. Thoroughly demonstrates fundamental techniques and plays. Slow motion, stop motion, and normal speed motion.

Technique of Playing Basketball. Y.M.C.A. 3 reels, rent $5.00 and each additional day $1.00. The official picture of the Chartered Board of Approved Basketball Officials.

Women's Basketball. Scholastic Coach Bookshop, 250 E. 43rd St., New York City, 1 reel, rent $2.00. "Practice of catching, passing, guarding, shooting, in various formations. Game demonstrated. Slow motion analysis of techniques."

V. BOATING

America's Cup. Mogull 1 reel $.50. Boat Racing.

Annual Classics. Mogull 1 reel, rent $.50. New York's race around Manhattan, track events in Philadelphia, the Lipton Yacht Race, California's Annual Regatta.

Deck Sports. Burton Holmes 100 ft., sale $5.00. The Japanese crew entertains passengers aboard the Aki Maru.

Floating Fun. Gutlohn 1 reel, rent $2.00. Sailing and motor boating.

Gangway. Kodascope 1 reel, rent $1.00. Scenes on board fast cruisers or destroyers in a heavy sea off the Delaware Capes. Next follows a very peaceful scene of small yachts racing in the Larchmont Yacht Club Regatta. Canoeing and sailing scenes on Lake George.

Nipigon Trails. Y.M.C.A. 1 reel, free. A picturesque canoe trip down the famous Nipigon River.

Outboard Stunting. Gutlohn 1 reel, rent $2.00. Thrilling feats on outboard motors.

Paddling in Perils. Willoughby 1 reel, rent $.50.

Rowing. American Olympic Committee 1 reel, rent $4.00. Official Olympic Film 1936.

Speed Limits. Gutlohn 1 reel, rent $2.00. Auto and speed boat racing.

Spills and Thrills. Bass 1 reel, rent $1.25 sound; Mogull rent $.50, sound rent $1.00. Stunts with outboard motor boats, aquaplaning over hurdles and water skiis.

Sports of Sailormen. Y.M.C.A. 1 reel sound, free; Akin silent $.50. United States Navy film. Scenes of boxing, wrestling, football, fencing, and some of the Navy's own distinctive sports.

Surf and Sail. Kodascope 1 reel, rent $1.25. Scenes of outboard motor racing; day cruisers; motorboat racing; sailing craft of different types and sizes; charting the course, hoisting sail and under way.

Surfboard Riding. Mogull 1 reel, rent $.50.

Surfing—Famous Sport of Waikiki. Burton Holmes 100 ft., sale $5.00. All the thrills of riding the surf boards.

Training an Eight Oar Crew. Kodascope 120 ft. plus comedy, rent $1.00. Men in training for college crew races. The proper strokes on rowing machines and an indoor lake are shown. Rowing practice on the river and the big race.

VI. BOXING

Battalino-Petrolle Fight. Mogull 1 reel, rent $.50. Boxing at Madison Square Garden, March 1932.

Boxing. Mogull 1 reel $.50. Boxing form, Schmeling-Stribbling Fight. Tunney in Training.

Boxing. Mogull 3 reels, rent $1.50. World's heavyweight championship boxing contest between Gene Tunney, heavyweight champion of the world and Tom Heeney, heavyweight champion of New Zealand, held at the Yankee Stadium, New York City. Complete fight, round by round shown.

Champions of the Ring. Mogull 1 reel, rent $.50. Boxing with Dempsey vs. Tunney, Tony Canzoneri vs. Kid Berg, Al Singer vs. McLarnin.

Dempsey, Tunney. Mogull 1 reel $.50. Dempsey fighting vs. Firpo, vs. Tunney.

Flying Leather. Gutlohn 1 reel, rent $2.00. Amateur boxing at its best.

Gene Tunney vs. Jack Dempsey. Mogull ¼ reel, rent $.50. Scenes of actual fight.

Idols of Millions. Bell and Howell 2 reels, rent $1.50. Boxing—Jack Dempsey.

Louis vs. Schmeling. Mogull 1 reel, rent $.50. A blow by blow description filmed in 1936.

Self Defense. Mogull 1 reel, sound $1.00. Seventy-five pound sluggers show how they are taught the art of self-defense at Culver.

Stamina. Mogull 1 reel, rent $.50. Boxing at West Point, wrestling, 8 oar crews at Annapolis, Notre Dame—Navy Football game.

Tommy Grogan vs. Ray Miller. Mogull 1 reel, rent $.50. Boxing for the lightweight championship.

VII. CAMPING.

Camp Sanitation. National Motion Picture Company 1 reel, sale 16mm. $40.00, 35mm. $100.00. A one reel educational motion picture, showing sanitation in camps and rural districts where modern sanitary features are not always obtainable.

Day in a Boy Scout Camp, A. Mogull ½ reel, rent $.50.

Getting Gay with Neptune. Kodascope 1 reel, rent $1.00. A very fine sport subject illustrating the delightful phases of life in a girl's camp in Maine. Splendid scenes of swimming, diving and canoeing are shown. Several canoe races with so-called war canoes "manned" by feminine crews of a score or more in each canoe. The closing scenes are of the "Water Spirit" as exemplified in a very fine swimmer clad in diaphanous floating draperies, giving an almost bird-like effect in the water.

Joys of Camping—Bruce Scenic, The. Y.M.C.A. 1 reel $1.50. Bringing to the scene the joys of the campers' life.

Mountaineering Memories. Y.M.C.A. 1 reel, free. Efforts to climb the tremendous glacier, Mount Assiniboine.

VIII. DANCE

Creative Dance Films. Betty Thompson, Oregon State College, Corvallis, Oregon, 1,000 ft., rent $5.00 per 400-ft. reel or $8.00 for two and if 100-ft. reels are to be included, $10.00 for the complete set. One 400-ft. reel shows class techniques ranging from beginning through intermediate and advanced work. A second 400-ft. reel showing dances created for recital work includes one group

of dances called "Episodes From a Trial" and part of another group entitled "Campus Moods." "Episodes From a Trial" includes "The Crime," "The Mob," "The Jury," and "The Man and His Conscience." "Campus Moods" includes "Work," Gayety," and "Romance." This 400-ft. reel also contains a percussion study by an advanced group and two sports numbers entitled "Skaters" and "Fishing for Steelheads." This latter dance was worked up in response to a request from one of our fisherman friends. Miss Thompson has also two 100-ft. reels, one in color showing a dance called "Fireworks;" and the other of one of her graduate students in solo work in parts of three numbers, "Sarabande," "Obsession," and "Waltz."

Dance Techniques. Minnesota University 2 reels. With synchronized accompaniment.

Demonstration of Dance Technique. Ohio University, Athens, O., 2 reels, rent $10.00. "Reel one illustrates dance movement; reel two, compositions in costume. Both reels arouse interest in dance, but the film is not sufficiently detailed to assist in learning the activity. No slow motion. Numerous medium close shots of group leaders. Films of more value to teacher than student."

High School Modern Dance Film. H. Knight, Morton H. S., Cicero, Ill., 1½ reels (30 minutes to project), rent $5.00 per week. Consists of techniques, such as preliminary stretches, movement techniques, techniques in compositional form, sketches and compositions.

Mary Wigman and Her Group. Virginia Stewart, 678 South Lafayette Park, Los Angeles, Cal. Films of the school of Mary Wigman and a group on compositions.

Modern Rhythm. Y.M.C.A. 1 reel, rent $1.00; Bass rent $.50. Ballet dancing, fox trot, charleston, and hula hula.

On With the Dance. Bass 1 reel sound, rent $1.25.

Polyrythmic Exercise. E. W. Wilson 425 ft., rent $2.50, 1936. "Titles and analysis follow specific lessons in Teacher's Guide in Secondary Education. Some slow motion."

Rhythmic Action. California University 4 reels, rent $2.00. Of special interest to teachers, produced at the California elementary training school. Activities of children on the nursery school playground. Creative work and play in the grades from the first through the seventh. Interpretation and expression through rhythmic motion.

Techniques, Tool of Composition and Completed Composition by High School Dance Club. Helen Knight, Morton H. S., Cicero, Ill., 1½ reels, rent $5.00 per week.

IX. EQUITATION

Closing Ceremonies and Equestrians. American Olympic Association, rent $4.00. Official Olympic Film.

Hoot Gibson Rodeo. Akin 1 reel, rent $.50. Fast moving film of cowboys and girls, broncho busting, steer-riding, etc.

Riders of Riley. Gutlohn 1 reel, rent $2.00. Horsemanship by Cadets.

She's Wild. Akin 1 reel, rent $.50. Cowboys on the western cattle ranges with "broncho busting," roping, etc.

Sky High Stampede. Akin 1 reel, rent $.50. Rodeo time. Parade, Indians, floats, with cowboys and cowgirls in action.

Where West is Still West. Burton Holmes 1 reel, rent $1.50. The round-up, branding, riding, and pastimes during a day on the range.

X. EXERCISE

Analysis of Exercises Performed with a Rhythmical Swing. Gaumont British 35mm. 1 reel. An analysis of typical exercises performed with a rhythmical swing,

illustrated by views of class work and by "close-up" photography of individual boys and girls.

Exercise. Edited 1 reel, rent $1.50. Development of muscles, strengthening bodily organs; chest and lungs; value of swimming.

Exercise. Institutional Cinema Service 1 reel, rent $1.50, sale $24.00; Akin rent $.50. A hike with boy scouts; signaling, games, various exercises for muscular development; making a fire and cooking a meal; various swimming strokes; floating and diving; rescue and resuscitation of a drowning person. Activities of Girl Scouts and Camp Fire Girls; games, races, competitive athletic events, and tennis.

Exercise. DeVry 1 reel, sale $24.00; Iowa rent $1.00; Mogull rent $.50; Y.M.C.A. rent $1.50. The specific aim of this lesson is to recall the joy of invigorating exercise; to show how cooperation with others may enlarge pleasant associations and social relations; to show how individual efficiency, promptness and subordination enhance the success and welfare of any organization; and to encourage the practice of healthful exercise through games that develop growth, strength, and skill as an individual and adaptability as a member of a group or team.

Health Exercise. Mogull 1 reel $.50. How calisthenics prolong life.

Outdoor Exercises for Children. Pinkney 1 reel 16mm., sale $23.00, rent $1.50-$2.00; 35mm. sale $65.00, rent $2.50-$.3.00.

Polyrhythmic Exercise. E. W. Wilson 425 ft., rent $2.50, filmed 1936. "Titles and analysis follow specific lessons in Teacher's Guide in Secondary Education. Some slow motion."

XI. FENCING

A Lesson in Swordsmanship. Kodascope 120 ft. with 260 ft. of "A Day with the Gypsies," rent $1.25. A fencing class at Columbia University with Samuel Shaw, former American champion, giving instructions. The proper way to hold a foil and correct body balance. Exhibitions of fencing and sabre dueling are shown.

Sport of Fencing. Pictorial 1 reel sound, rent $2.00, sale $25.00. Featuring members of the American Olympic Team.

XII. FISHING

Angles of Angling. Gutlohn 1 reel, rent $2.00; Mogull 1 reel sound, rent $1.00.

An Order of Fish. Kodascope 1 reel, rent $1.25. Trout, bass, and fluke fishers.

Battling Silver Kings. Gutlohn 1 reel, rent $2.00. Fishing as a true sport.

Big Muskies. Bass 1 reel, rent $.50. Fly fishing in Glacier National Park. Trout fishing at its best in a magnificent mountain setting. This film also depicts the capturing of a shark.

Cobb Goes Fishing. Mogull 1 reel, rent $.50, sound film rent $1.00. A Grantland Rice Sportlight giving you intimate closeups of the famous writer, Irvin S. Cobb.

Fish and Fishing for Everybody. Y.M.C.A. 1 reel, free. Fish incubation—excellent for biology classes.

Fish From Hell. Kodascope 3 reels, rent $3.75. Catching tuna and capturing a shark. Harpooning of a giant manta. An escape from an octopus. A fight with a whale and a swordfish.

Fishing. Gutlohn 1 reel sound, $50.00; Mogull silent, rent $.50. We are taken to various parts of the world and shown: (a) A fisherman casting for salmon on the lower Humber in Newfoundland. (b) Trout rising to the fly on the Nipigon River in Ontario. (c) Fisherman seining the Sea of Galilee in Palestine. (d) Tunny fishing in Sicily.

Fishing Gamely for Game Fish. Y.M.C.A. 1 reel, free. Useful hints concerning modern fishing tackle and how to achieve the best results.

Fishing Time. American Museum Natural History 1 reel, free. This picture was photographed on the picturesque Nipigon River, noted for its magnificent scenic beauties. We see the Virgin Falls near Nipigon Lodge, a canoe portage through a pine forest, fishing in the rapids and catching speckled trout.

Fresh From the Deep. Y.M.C.A. 1 reel, free. Catching halibut.

Harvesting the Deep. Y.M.C.A. 1 reel, free. Gathering a harvest of cod, haddock, flounders, and other fish off the Cape Sable banks.

Hook Line and Melody. Mogull 1 reel sound, rent $1.00; Gutlohn 1 reel, rent $2.00. A canoe trip into the wilds of Northern Ontario.

In Quest of the Bronze Back. Y.M.C.A. 1 reel, free. A bass-fishing expedition of Lake Werlemodon.

Inshore Fishing on the Atlantic Coast. American Museum Natural History 1 reel, free. A highly interesting marine picture produced in cooperation with the Department of Marine and Fisheries, showing the work of Canada's Atlantic fishermen.

Just What the Doctor Ordered. Y.M.C.A. 1 reel, free. A fishing trip.

Monsters of the Deep. Kodascope 2 reels, rent $2.50. Landing of bass and tuna using barbless hooks. Whalers in action. The catching of other monsters.

Oregon—The Sportsman's Paradise. Izaak Walton League, Salem, Oregon. 450-foot reel, rent $1.00, sale $28.00. The picture shows deep sea fishing off Oregon coast, lake fishing in the high Cascades, Chinese pheasant hunting, duck and goose shooting, Chinook salmon fishing, steelhead fishing, red-side trout in the beautiful McKenzie, beagles hunting rabbits, all interspersed with wonderful scenery.

Rod and Reel Champions. Kodascope 84 ft. on same reel as "How Do You Get Your Exercise," rent $1.25.

Tarpon Fishing. Willoughby 1 reel, rent $.50.

Tigers of the Deep. Gutlohn 1 reel, rent $2.00. Big game fishing off the Florida coast.

Important—See Field and Stream Catalogue of Films.

XIII. FOOTBALL

Backfield Aces. Mogull 1 reel $.50. Rockne Football Series.

Champion Makers. Bass 1 reel sound, rent $1.25. Shows us in detail just how some of the country's famous college mentors coach their teams.

Columbia vs. Stanford at Rose Bowl. Mogull 2 reels, rent $.85. Complete game taken at Rose Bowl.

Controlled Kicking. Pathé News 1 reel, 16mm. silent $24.50; 16mm. sound $29.75, 35mm. sound or silent $45.00.

Deception. Bell and Howell 1 reel, rent $1.50.

Diving—California, Pitt Football Game. Willoughby 1 reel, rent $.50.

Flying Feet. Mogull 1 reel, $.50. Rockne Football Series.

Football. Pinkney 1 reel 16mm., sale $23.00, rent $1.50-$2.00, 35mm. sale $65.00, rent $2.50-$3.00; Mogull 1 reel, rent $.50.

Football. R. E. Priebe, Fullerton Union H. S., Fullerton, Cal., 1 reel $2.00 per day, $5.00 for three days. All slow motion, close-up on fundamentals—instructional film.

Football. Films Incorporated 4 reels sound-on-film, rent $10.00, single reels rent $3.00.

Part 1: *Kicking.* Illustrates the proper technique for holding and kicking the ball on kick-offs, punts, drop and place kicks. Shows team play and formations for going down under kicks; returning kick; protecting the kicker; blocking kicks; catching and returning kicks.

Part 2: *Running*. Illustrates proper technique going into the line; inside and outside tackle plays; around end; slants; cut-backs; reverses and fake reverses. Technique of avoiding tacklers. Demonstrations of blocks. Typical huddles and shifts.

Part 3: *Defense Against Running Attacks*. Individual player's assignments demonstrated and discussed with best methods for getting across the line to make tackles. Defense formations shown and discussed. Tackling technique in all its phases.

Part 4: *The Passing Game*. How to pass effectively. The strategy of passer-protection and getting men into the open for receiving. Pass defense: demonstrates individual assignments for zone and man-to-man defense formations. Lateral or backward passes: a full demonstration of their execution and effective use.

Football for the Fan. Gutlohn 6 reels, rent $12.00; Garrison rent $1.50 per reel, sale $40.00 per reel. A series of six single reels on college football, presented by Howard Jones in collaboration with twenty-five of the leading college coaches. Each reel covers its titled subject and important points are carefully demonstrated by slow motion photography. Reel 1—Spring Training. Reel 2—Wedge Play. Reel 3—Kicking. Reel 4—Deception. Reel 5—Forward Pass. Reel 6—Penalties.

Kickoff, The. Capital. Supervised by Howard Jones, University of Southern California Football Coach.

Forward Pass. Bell and Howell 1 reel, rent $1.50.

Hidden Ball. Mogull Brothers 1 reel, rent $.50. Rockne football series.

Iowa-Colgate Football, 1935. Iowa University 1 reel, rent $.35. This film shows scenes from the Iowa-Colgate football game played at Iowa Stadium. October 12, 1935.

Iowa-Illinois Football, 1935. Iowa University 2 reels, rent $.70. This film shows scenes from the Iowa-Illinois football game played at Memorial Stadium, Urbana, Illinois, October 26, 1935.

Iowa-Iowa State Football Game, 1933. Iowa University 1 reel, rent $.35. This film shows many scenes of interest during the Iowa State football game at Iowa City on November 4, 1933.

Kicking. Bell and Howell 1 reel, rent $1.50.

Last Yard. Mogull 1 reel $.50. Rockne football series. Notre Dame team shows the offensive play.

Modern Football Fundamentals. California University 2 reels, rent $2.00; Eastman sale $48.00; Kansas University rent $1.50; Wisconsin rent $2.00 includes teaching guide. This film shows in detail, through scenes taken under actual training condition, the fundamental football techniques and drills. Definite methods of handling the body to prevent injuries are demonstrated. Reel 1 stresses drills for individual and small groups. Reel 2 illustrates group and team drills.

Notre Dame-Kansas Football Game of 1932. Y.M.C.A. 2 reels, rent $1.50.

Penalties. Bell and Howell 1 reel, rent $1.50.

Pigskin Progress. Gutlohn 1 reel, rent $2.00. Football whys and wherefores.

Rose Bowl Game 1937. California University 1 reel, rent $1.00. The University of Pittsburgh versus the University of Washington in the annual Rose Bowl Game.

Six Knute Rockne Original Football Plays. Capital. 1, Last Yard; 2, Hidden Ball; 3, Flying Feet; 4, Touchdown; 5, Two Minutes to Go; 6, Backfield Aces.

Spring Training. Bell and Howell 1 reel, rent $1.50.

Stanford-Southern Methodist Rose Bowl Game, 1936. Akin ½ reel, rent $.25.

Touchdown. Akin 1 reel, rent $.50. Knute Rockne gives instructions in passing the ball. Also victory plays.

Two Minutes to Go. Mogull 1 reel, rent $.50, sound rent $1.00. Rockne Football Series. Many fine points of the game illustrated.

Wedge Play. Bell and Howell 1 reel, rent $1.50.

XIV. GOLF

Bobby Jones. Willoughby 1 reel, rent $.50; Mogull rent $.50. The great golfer's arms and hands, his grip, drives and putts, shown in ordinary and slow motion speed.

Bobby Jones, National Golf Champion. Kodascope 229 ft. on same reel with Francis Ouimet, golfer, rent $1.25. By means of both normal and slow motion photography this prominent golfer demonstrates correct golf form in the use of the different clubs. Upper body and foot position and motion are analyzed.

Bobby Jones (golf) Walter Hagen (golf) Felix in the Swim. Willoughby special combination film 1 reel 400 ft., rent $.50.

Driving. Burton Holmes 100 ft., sale $5.00. Jack Redmond illustrates the mistakes common to beginners and how to correct them.

Fairway Favorites. Mogull 1 reel sound, rent $1.00.

Golf. Burton Holmes ¼ reel, rent $.75; Mogull 1 reel sound $1.00. Jack Redmond illustrates the mistakes common to beginners and how to correct them.

Golf. Professional Golfers Association, 150 Nassau St., N.Y.C. 3 reels. "Bobby Jones, Joyce Wethered, Harry Vardon. Drives analyzed; separate reels. 200 times slower than normal, 3200 exposures per second. Very slow motion obviates need of close-ups. Instructor's lecture essential. Excellent for analysis at any age or skill level."

Golf and How. Pinkney 1 reel 16mm., sale $23.00, rent $1.50-$2.00. 35mm. sale $65.00, rent $2.50-$3.00.

Golf and Tennis. Mogull 1 reel $.50. Bobby Jones and Bill Tilden.

Golf Hints, Form, and Models of Health. Mogull 1 reel, rent $.50. Different illustrations of the great game. Also some exercises.

Golf Series. Burton Holmes 100 ft., rent $3.00. "The drive. No slow motion. Too many negative captions. Slight value to advanced golfer, if any."

Happy Duffer, The. Kodascope 393 ft., rent $1.25. During the duffer's progress are shown some of the correct methods of holding the clubs as well as some of the peculiarly clumsy methods for which the average duffer is famous.

Happy Golf. Wisconsin 1 reel sound, rent $1.00; Mogull rent $1.00. Alex Morrison presents an illustrated lecture on how to make golf a really happy game. He makes his drives to the tune of a jazz band and gives some valuable hints on how to improve.

How I Play Golf. Warner Bros. 13 reels, rent $40.00 per day. Bobby Jones Golf Series. "Combination entertainment and instruction film. Slow motion analysis of different club shots, helpful mainly to intermediate and advanced golfer. Excellent close-ups emphasizing grip, back swing, and follow through. Some diagrammatic and suspended action analysis* and also teaching hints. Women's costumes date film and should be cut. Reel emphasis for instruction is as follows: Reel 1 and 2—Putting; Reel 3 and 4—Suspended action of niblick out of trap; Reel 5—Some slow motion mashie niblick; Reel 6—Shots from tee—analysis of 140 yard mashie shot; Reel 7—Analysis of approach shots with slow motion and suspended action; Reel 8—Spoon shots; Reel 9 and 10—Drives; Reel 11 and 12—Out-of-trouble shots; Reel 13—Round of golf on screen—each shot played, then analyzed—slow motion."

Par and Double Par. Bell and Howell 1 reel, rent $1.50; Gutlohn rent $2.00; Mogull rent $.50, sound rent $1.00. Brilliant golf by Bobby Jones demonstrating his composure under the strain of tournament play.

XV. GYMNASTICS

Gymnastics. American Olympic Association 1 reel, rent $4.00. Official Olympic film 1936.

* Bobby Jones explains each shot as he makes it, giving its analysis and also teaching hints.

XVI. HOCKEY

Field Hockey. United States Field Hockey Association 3 reels.
Reel 1. Expert players, many of whom are United States Hockey Association players, includes stick work, dodges and tackles.
Reel 2. Includes formations for teaching and group work.
Reel 3. Is an umpiring film including the positioning of officials and demonstration of all fouls.

Field Hockey. American Olympic Association 1 reel, rent $4.00. Official Olympic film 1936.

Hockey. Gutlohn 1 reel sound, rent $3.00, sale $40.00. This reel was made with the stars of the Boston Bruins to show just how hockey is played. The details of play, with the aid of slow motion photography, are shown.

World's Fastest Game. Gutlohn 1 reel. "Boston Bruins clearly analyze techniques. A.B.C. analysis of attack and defense by shots made trucking the camera. Clem McCarthy gives instructive description. Newsreel clips add interest though underexposed. For Junior High School, High School and College."

XVII. HUNTING

Bob White. Gutlohn 1 reel, rent $2.00. Quail hunting.

Ducks and Drakes. Gutlohn 1 reel, rent $2.00. Duck hunting.

Duck Shooting. State of Maryland Game Division 35mm., free.

Hunting Thrills. Gutlohn 1 reel, rent $2.00. Capturing alligators by hand.

Pack and Saddle. Gutlohn 1 reel, rent $2.00. Real hunting.

Quail Hunting. Kodascope 1 reel, rent $1.25. From the "Field and Stream" series of sports pictures. Shots of dogs and hunters in action are afforded the spectator.

Quail Shooting. State of Maryland Game Division 35mm., free.

Wild Turkey Hunting—Ruffed Grouse—Rabbit Hunt. State of Maryland Game Division 35mm., free.
Note: See "Field and Stream" Catalogue.

XVIII. JUJITSU

Jujitsu. Bray 73 ft. on same reel with "Contest," rent $1.00. Many different holds are shown and the methods of breaking them.

XIX. LACROSSE FOR WOMEN

Lacrosse for Women. Helena Wheeler, 950 ft., rent $3.00; free to members of United States Women's Lacrosse Association. English film made under the auspices of the All-England Women's Lacrosse Association; showing time 50 minutes. "Filmed under the auspices of the English Women's Lacrosse Association. Some analysis of separate techniques. Filming of game situation. For intermediate and advanced players."

Lacrosse for the Inexperienced Players and Coaches. Helena Wheeler, 950 ft., rent $3.00. "Film under the supervision of Maude V. S. Sharpe and Phylliss Vare. Good analysis of beginning techniques. Player filmed from various angles. Some slow motion."

XX. OLYMPICS

Eleventh Olympics, The. University of Kansas 1 reel, rent $1.50.

Highlights of the 1936 Olympics. Institutional 1 reel, rent $1.50, sale sound $25.00, silent $17.00; California University 1 reel, rent $1.00; Films Incorporated rent

$3.00. Events depicted are: Women's javelin throw, high jump, 100-meter dash, broad jump, 200-meter dash, discus throw in slow motion, high hurdles, men's javelin throw, 1500-meter race, pole vault, women's 400-meter relay, winners of Decathlon, men's 400-meter relay, start, intermediate, and finish of the 26-mile marathon race, various women's and men's diving, 100-meter swim race, and the eight oared boat race closes this sports classic.

International Olympic Games. Y.M.C.A. 1 reel, rent $1.25. Summer 1932—Los Angeles, California.

International Olympic Games. Y.M.C.A. 1 reel $1.25. Winter 1932—Lake Placid, New York.

Olympic Games at Los Angeles. Iowa 4 reels, rent $4.00; Mogull 2 reels $.50. Description of Iowa reels. None given for Mogull. This interesting film shows scenes from the opening ceremony and parade of nations to the closing events and torch ceremony. Scenes from the following events are shown; discus, hop, step and jump, broad jump, hammer throw, javelin, pole vault, 800 meter, 400 meter, steeple chase, 200 meter, 80 meter hurdles, 5000 meter, high jump, marathon, rowing, swimming, diving, boxing, lacrosse, hockey, gymnastics and equestrian events.

Olympic Games of 1936. Willoughby 1 reel, rent $.50; Mogull rent $.50.

Olympic Opening Ceremonies. American Olympic Committee 1 reel, rent $4.00. 1936 official film.

Olympic Talent. Gutlohn 1 reel, rent $2.00. Olympic talent in the making.

Tenth Olympiad. Bell and Howell 1 reel, rent $1.50; Mogull 1 reel sound, rent $1.50; Wisconsin 1 reel sound $1.00. A dramatic presentation of the world's greatest sport headline. The starts, the finishes, close-ups of the winning athletes—all the high spots of the great contest are presented in the huge stadium in Los Angeles.

XXI. POLO

The Sport of Kings. Mogull 1 reel, rent $.50. Grand National Steeplechase, Polo games.

XXII. RECREATION

Human Crop. Department of the Interior 16mm. and 35mm. sound only, free. Story of the recreational demonstration areas which are being developed by the National Park Service. It shows the need for organized camping facilities throughout the country.

XXIII. SPEEDBALL AND SOCCER

Attack. Gaumont British 1 reel. As attacking constitutes a variety of measures, practically the whole of the Arsenal team appear in this reel which concerns itself purely with tactics as applied to attack. Correct positioning, the right moment to pass, backing up and other essentials of vigorous attack.

Ball Control. Gaumont British 1 reel 35mm. and 16mm. Trapping, heading, dribbling, short passing and methods of deceiving an opponent. Star players show how these movements should be done.

Defense. Gaumont British 1 reel 16mm. and 35mm. The first part deals with individual defensive efforts. The second part with general team defense.

Goal Keeping and Throwing-In. Gaumont British 1 reel 16mm. and 35mm. Hibbs, idol of England's football public for almost a decade, and one of the greatest goal-keepers English football has produced, was filmed for the first time in this reel.

Kicking. Gaumont British 1 reel 16mm. and 35mm. Star players demonstrate pen-

alty, free goal, and corner kicks to show possibilities with a stationary ball. Kicking a moving ball on the ground, the half-volley, the volley and the overhead kick are shown in detail.

Soccer and Field Handball. American Olympic Committee 1 reel, rent $4.00. Official Olympic film 1936.

Speedball for Girls. Frances T. Duryea, 238 North Columbus Ave., Glendale, Calif., 1 reel 200 ft. 8 minutes, rent $1.25. "To be reviewed. Described as analysis of various techniques and team plays. Junior High, Senior High, College."

Tactics. Gaumont British 1 reel 16mm. and 35mm. Specialized tactical movements for attack and defense. Outlined by well known players.

Training and Practical Hints. Gaumont British 1 reel 16mm. and 35mm. For schoolboys. Primarily a resume of main essentials such as training hints, correct footwear, costume, and certain tactical movements.

Winter Games. Gaumont British 1 reel 35mm. A typical organized field-games lesson for a class of boys aged 11. Includes Association Football and Rugby Touch, together with group practices leading to these games.

XXIV. SWIMMING AND WATER SPORTS

Aquatics. Mogull 1 reel, rent $.50. Shots of water sports.

Back Strokes. Gaumont British 1 reel.

Breast and Butterfly Strokes, The. Gaumont British 1 reel.

Crawl, The. Gaumont British 1 reel.

Crystal Champions. Bass 1 reel sound-on-film, rent $1.25; Bell and Howell rent $1.50; Gutlohn rent $2.00; Mogull rent silent $.50, sound $1.00; Willoughby 1 reel rent $.50; Wisconsin rent $1.00 includes teaching guide; Y.M.C.A. rent $1.00; Akin rent $.50. "Scenic underwater shots at Silver Springs, Florida. Crawl stroke by Martha Norelius and Johnny Weissmueller. Excellent slow motion of diving techniques demonstrated by Helen Meany and Pete Desjardines. Film is interest arousing to all age groups; helps intermediate and advanced swimmers in improving skill."

Development of Speed in Training. Gaumont British 1 reel.

Diver, The. Willoughby 1 reel, rent $.50.

Diving. Wholesome 1 reel 35mm. "Al White, Pete Desjardines, Aileen Riggin, Helen Wainwright demonstrate platform and springboard diving. Natural setting. Slow motion occasionally emphasizes height. Reel is good historical record of champions. Has entertainment value for any age level."

Diving. Roy Priebe, Fullerton, Cal. H. S., 1 reel, sale $15.00, rent $2.50 per day $4.00 per week. "Demonstrated by Johnny and Mickey Riley. No good close-ups. Slow motion analysis aids decidedly in improvement of skills. Titles not accurately stated. Valuable for analysis to teacher and advanced swimmer."

Diving. Chicago Park Department 1 reel, sale $20.00. A complete series of slow motion dives with titles—55 dives in all, slow motion analysis of compulsory dives of the six final contestants are shown, including Wayne, Degener, Greene, Patterson, Patnick, and Galatzen.

Floating and Ornamental Swimming. Gaumont British 1 reel.

Follow the Leader. Kodascope 1 reel, rent $1.00. Swimming, taken both in slow motion and at normal speed under various conditions in different parts of the United States.

Front Crawl, The. Grace B. Daviess, Ohio State University, 2 reels 400 ft. each, 1 reel 100 ft., 40 minutes, sale $24.00 each, rent $3.00 each. "Reel 1—Analysis. Reel 2—Analysis of advanced. Includes Lenore Knight Wingard in normal and racing tempo. Both analyzed with slow motion; close-ups. For instruction only. Experimental, supervised by the committee."

Learn To Swim. Kansas University 1 reel, rent $1.50.

Men's Platform Diving. American Olympic Committee 1 reel, rent $4.00. Official Olympic Film 1936.

Men's Springboard Diving. American Olympic Committee 1 reel, rent $4.00. Official Olympic Film 1936.

Poetry of Motion and Olympic Diving Champions. Gutlohn 1 reel sound, sale $50.00. Here our Olympic Diving Champions demonstrate the perfect form and grace that makes them champions of this sport. Slow motion pictures.

Swimming and Diving. Society Visual Education 2 reels, rent $3.00, sale $40.00; Society Visual Education 35mm., rent $4.00, sale $75.00; California, rent $1.00. Exhibitions of swimming and diving. The picture presents such nationally known stars as Johnny Weismueller and both slow motion and normal photography are used to emphasize correct form in each event. "Illustrates breast stroke, crawl strokes, some dives and few life-saving techniques. Little slow motion, no close-ups. Of slight interest and value only to high intermediates and advanced swimmers."

Swimmers and Swimming. Kodascope 303 ft. on same reel with Fox Hounds and St. Bernards. Rent $1.25; Mogull rent $.50. The first step in which children are taught the preliminary swimming motions at their play. Swimmers progressing through the successive stages of learning to be efficient in the water. Partially in normal and partly in slow motion the crawl, breast, trudgeon and other strokes are illustrated. Imitations of the swimming methods of various animals, viz., the frog, seal, porpoise, and crab.

Swimming. Society Visual Education 2 reels, rent $2.00. "Reel 1—Interest shots older and young swimmers. Children's lessons in crawl under Hungry Duck, Motor Boat, etc. Kojac demonstrates back crawl, breast stroke; Jackie Ott demonstrates underwater swimming, swan dive, dog and duck. Title value over demonstration. Sequence of lessons might stimulate individual practice. More footage needed on stroke analysis, slow motion."

Swimming. California University 1 reel, rent $4.00. "Slow motion analysis of strokes and dives. No close-ups. Useful for interest of all levels; skill improvement of advanced swimmers for diving."

Swimming. Twentieth Century Fox 1 reel, 16mm. sale $25.00, 35mm. sale $75.00.

Swimming. Mogull ½ reel, rent $.50. The eighth coordination of the American Crawl.

Swimming. Edited 1 reel, rent $1.50. Various swimming strokes used by modern stars, showing normal speed and slow motion action of arms and legs both above and below the water line.

Swimming. Edited 2 reels, rent $2.00. Shots of picked swimmers displaying approved forms for most of the modern strokes.

Swimming and Water Polo. American Olympic Committee 1 reel, rent $4.00. Official Olympic film 1936.

Swim or Sink. Gutlohn 1 reel, rent $2.00. Swimming with champions and novices.

Water Bugs. Gutlohn 1 reel, rent $2.00. Champion swimmers and divers.

Water Polo. Gaumont British 1 reel 360 ft.

Water Sports. Willoughby 1 reel, rent $.50.

Water Wonders. Kodascope 1 reel, rent $1.25. Dry swimming practice is given a class on the side of an outdoor pool. The instructor then demonstrates diving and swimming, followed by the class. Unusual opportunity to study the swimmers is afforded by seeing them from below the surface. Scenes in normal and slow motion. Johnny Weismueller, holder of speed records for distances from 50 to 500 yards, doing the crawl. Helen Meany, Olympic diving champion, and "Pete" Desjardines, springboard and high diving expert in dives, and then Weismueller and Martha Norelius a tandem team in the crawl and back stroke.

Women's Springboard and Platform Diving. American Olympic Committee 1 reel, rent $4.00. Official Olympic Film 1936.

Women's Swimming. American Olympic Committee 1 reel, rent $4.00. Official Olympic film 1936.

XXV. TENNIS

Backhand, The. Gaumont British 16mm. and 35mm. This film shows how the world's great players, including Fred Perry, Mary Heeley, and Helen Jacobs, play their backhand shots. Other great players, including Miki, the Japanese player, demonstrate their own particular methods.

Better Tennis. Kansas University 1 reel, rent $1.50; Mogull ¼ reel, rent $.50. Instructions and demonstrations by the famous Helen Wills. "William Tilden as instructor; and demonstration by Tilden and Helen Wills Moody showing service. Film in poor condition, therefore not recommended. Filmed 1927."

Championship Tennis Game, A. Kodascope 265 ft. on same reel with "The Clown Pup," rent $1.00. Two tennis champions, William M. Johnston and Gerald L. Patterson, in fast action before a slow motion camera.

Dorothy Round. Gaumont British 1 reel 16mm. and 35mm. England's great Wightman Cup player is seen in this film demonstrating all the brilliant shots she has in "her bag."

Forehand Drive, The. Gaumont British 16mm. and 35mm. 1 reel. Miki, the Japanese Davis Cup player, and Horace Skete, All-England professional, show the correct copybook way, and other great players are shown in actual play.

H. W. Austin. Gaumont British 1 reel 16mm. and 35mm. In this film Austin is seen in practice and court play demonstrating all his array of scoring and defensive shots.

Service, The. Gaumont British 1 reel 16mm. and 35mm. Mary Heeley demonstrates the correct way to play an "ace" service. Horace Skete, All-England Lawn Tennis Club professional, gives an initial display of coaching methods in which he shows the way he teaches his own pupils to serve correctly.

Tennis. Gaumont British 6 reel 16mm. and 35mm. both sound, rent (16mm.) $1.25 per reel and $25.00 six reels. "English professional illustrates old straight swing style of tennis in reels, illustrating forehand in reel 1, backhand in reel 2, service in reel 3, volley and smash in reel 4. Separate excellent reels of Dorothy Round and H. W. Austin demonstrating all strokes. Some slow motion; suspended action. Clips of Wimbledon matches give some opportunity to study court position. Junior High, Senior High, and College."

Tennis. California University 1 reel, rent $1.00. Davis cup matches at Germantown Cricket Club; general view of club and crowds. Allison defeated by Quist; slow motion showing Quist at play. Budge defeats Crawford: Serving, backhand strokes, footwork, smashing, all clearly demonstrated in slow motion. Mako, Budge, Crawford, Quist, play doubles.

Tennis. Edited 1 reel, rent $1.50. "Big Bill" Tilden, Molla Mallory and Helen Wills Moody in fast and slow motion.

Tennis. Mogull 1 reel, rent $.50. Made prior to 1927. Featuring Bill Tilden, Molla Mallory and Helen Wills, demonstrating the principles of correct tennis, strokes and styles of service in common use, exhibition and championship games.

Tennis. Mogull ½ reel, rent $.50. Bill Tilden in his usual form.

Tennis. Y.M.C.A. 1 reel, rent $1.00.

Tennis Form. Mogull ¼ reel, rent $.50. Analysis of the technique of Tilden, Johnston, Helen Wills, and others.

Tennis Topnotchers. Gutlohn 1 reel, rent $2.00. Tennis champions in action.

Volley and Smash, The. Gaumont British 1 reel, 16mm. and 35mm. Horace Skete, All-England professional and coach, gives a demonstration of correct "Copybook" styles, showing how he coaches his pupils, and later in actual practice

on the court. Mary Heeley, Miki and other celebrated tennis "Aces" all demonstrate their method of playing volley and smash shots.

XXVI. TRACK AND FIELD

Arms and Legs. Mogull 1 reel, rent $.50. A Grantland Rice Sportlight.

Breathtakers. Mogull 1 reel, rent $.50. Thrilling episodes in races and athletic events.

Field Events—Mostly in Slow Motion. American Olympic Committee 1 reel, rent $4.00. Official Olympic Film.

High Steppers. Bass 1 reel sound, rent $1.25; Mogull 1 reel sound, rent $1.00; Y.M.C.A. sound, rent $1.25. Cross country running, relay racing, 100 yard dash, walking, high hurdles; hop, skip and jump; pole vaulting and high jumping.

I.C.4A. Field Events. California University 1 reel, rent $1.00. Slow motion pictures of each event in the 1932 competition held in Edwards Track Stadium: shot-put, javelin, pole vault, high jump, discus, broad jump, and hammer throw; demonstrated by Gray, Metcalfe, Garber, Thomason, Miller, Conner, Van Ossdel, Jones, Barber, and Zaremba.

I.C.4A Track Events. California University 1 reel, rent $1.00. Slow motion picture of the 100 and 220 yard sprints, the one- and two-mile runs, 440 and 880 yard races, and the hurdles. Wykoff, Kiesel, Mangan, Hallowell, Carr, Eastman, McClusky, Bonthron, Turner, Fates, and Payne in the 1932 competition.

Interscholastic Cross Country Run and Iowa-Wisconsin Cross Country Run. Iowa ½ reel, rent $1.00. Scenes showing the Interscholastic cross country run and the Iowa-Wisconsin cross country run held at the University of Iowa, November 2, 1935.

Make or Break. Kodascope 1 reel, rent $1.00. Featuring athletic sports which have been popular with young men from the time of ancient Greece to that of the modern college man. Very excellent normal and slow motion photography portrays the actual effort involved in throwing the javelin, discus, and the hammer, putting the shot and the track sports of 100 yard dash, the mile relay, the high hurdle race, pole vaulting, and the running high jump.

N.C.A.A. Track Meet. Chicago Park Department sale $40.00. California University 2 reels, rent $1.50. Track meet of June, 1935, at Edwards Field showing 440 yard dash, 100 yard dash, Owens broad jumping, 120 yard high hurdles, 880 yard run, 220 yard low hurdles, 2 mile run. All in slow motion.

Thrills of the Track. Mogull Brothers 1 reel $.50. The great sport illustrated.

Track and Field. California University 1 reel, rent $1.00, Willoughby rent $.50. The technique of track and field: sprints, low and high hurdles, relay, high jump, javelin, discus, shot-put, broad jump, and pole vault. Demonstrated at the 1932 Olympic Games by famous track men such as Renner, Tay Ghan, Metcalfe, Lyman, and Garber. Prepared especially as a guide for coaches. Shown in slow motion.

Track—Marathon, Steeplechase, and Relays. American Olympic Committee 1 reel, rent $4.00. Official Olympic film 1936.

Track and Field Olympic Film. Chicago Park Department 6 reels, sale $20.00 per reel. Films all in slow motion. Important—write for Chicago Park list of films as they have many on Track and Field.

Track—100 Meters to 10,000 Meters. American Olympic Committee 1 reel, rent $4.00. Official Olympic film 1936.

Women's Track and Field. American Olympic Committee 1 reel, rent $4.00. Official Olympic film 1936.

XXVII. VOLLEYBALL

Volleyball. Irma Pelz, Teachers College of Connecticut, New Haven, Conn., 1 reel, rent $1.50. "Shows tournament of high school girls of Baltimore Public School

Athletic League. Slight interest value to Junior High, Senior High. Film badly worn."

XXVIII. WINTER SPORTS

Arctic Hike on Aletsch Glacier. Kodascope 1 reel 250 ft., with "Bobby Bumps' Last Smoke," rent $1.00. An expedition starts from the station at Jungfraujock to climb up toward the Glacier, which is 14 miles long and several miles wide and full of deep crevasses and reached only after some difficult climbing.

Frolics in the Frost. Wholesome 35mm. "Tobogganing, skiing, curling, skating, skate sailing, ice boating, snowskiing. Good entertainment film for Junior High, Senior High to arouse interest in outdoor winter activities."

High School of Skiing. Bell and Howell 1 reel, rent $1.50; Garrison sound-on-film rent $1.50, sale $50.00. Hans Schneider, famous ski champion, explains perfect skiing; made in the Alps; authentic. "Some slow motion analysis of Hans Schneider doing elementary techniques. Interesting scenic shots."

In a Glistening Paradise. California University 7 reels (1927), rent $10.00 in California and $15.00 elsewhere. Reels: 1—skiing in Tyrol valley; 2—conditioning gymnastics; 3—equipment; 4—elementary techniques; 5—advanced techniques; 6—jumpturns and jumping; 7—a ski tour. "No slow motion; a few close-ups. Film worn which accentuates underexposure. Value primarily interest as analysis incomplete."

Midwinter Sports in Quebec. Burton Holmes 100 feet, sale $5.00. Curling, snowshoeing and tobogganing at the famous winter resort.

Modern Ski Technique. Pathescope Company, 438 Stuart St., Boston, Mass., 2 reels, sale $25.00 per reel, rent for 2 reels $3.50. It is fully titled to explain how and how not to ski. Otto Schniebs of Dartmouth furnishes much of the skiing action in the films. "Some of the best performers in action. Common errors in turns analyzed. Elementary, Junior High, Senior High, and College. Guide."

Moosilauke Down Mountain Race. Pathescope Company, 438 Stuart St., Boston, Mass., 300-ft. reel, sale $25.00 rent $1.50. Otto Schniebs of Dartmouth furnishes much of the action for the films. "Excellent interest film of annual Dartmouth Down-hill Race; for all ages."

Olympic Winter Sports. American Olympic Committee 1 reel, rent $4.00. Official Olympic Film 1936.

Olympic Winter Sports at Garmisch-Partenkirchen. American Olympic Association 1 reel, rent $4.00. Official Olympic Film 1936.

Ski-Esta. Bell and Howell 1 reel, rent $1.50; California University 1 reel sound, rent $1.50; Pictorial sound, sale $25.00, rent $2.00; Institutional sound, sale $25.00, silent $17.00, rent on 16mm. and 35mm. $1.50. Stresses the elements of skiing, from actual class instruction to the more advanced phases of the thrilling sport plus pictorial beauty and real entertainment. "Men and women shown boarding a snow train; selecting equipment; doing mass exercises and practicing elementary techniques. Shows a ski cable, ski trail, and ski jumps. Good interest film because of actual situation. Mainly for adults."

Skiing and Skating. Mogull 1 reel, rent $.50. Interesting shots of different events.

Ski Pilots. Bass 1 reel sound, rent $1.25; Gutlohn rent $2.00. A Grantland Rice Sportlight showing snow skiing, sand skiing, ski jumping, and water skiing.

Ski Thrills. Nu-Art Filmco 1 reel, sale $31.50.

Ski Ways. Bell and Howell 1 reel rent $1.50.

Slalom. Films Incorporated 1½ hour, rent $20.00. A picture of ski experts in action on the famous ski slopes at St. Moritz, Switzerland. Background of unusual musical score. The German dialogue is not essential to the lightly drawn plot. Excellent for any audience.

Sonja Henie—Queen of the Silvery Skates. Nu-Art Filmco 100-ft. reel, sale. In this reel at St. Moritz, Switzerland, Sonja Henie gives thrilling exhibitions of her skill and grace which brought her fame and fortune.

Sports—Winter and Summer. Y.M.C.A. 1 reel, rent $1.00.

Swiss on White. Bell and Howell 1 reel, rent $1.50; California University 1 reel, rent $1.50; Garrison 1 reel sound-on-film, rent $1.50, sale $30.00; Mogull sound, rent $1.00. Winter Sports at St. Moritz with Maribel Vinson, Clarence Badger, Sonja Henie and other famous skaters performing on the ice. Switzerland plays hockey against Canada. Slow motion scenes. Music and narrator.

Take Your Pick. Gutlohn 1 reel, rent $2.00. Winter Sports in North and South.

What Country, Please? American Museum Natural History 1 reel, free. Tobogganing in Germany, ice-boating and skiing in Sweden, ice-skating in Holland, the ice-capped Andes, kangaroos in Australia, all combined with animation give educational value to this film.

When Winter Comes. American Museum Natural History 1 reel, free. A portrayal of the winter sports and other activities at Banff, the famous Canadian mountain resort in the Rockies.

Where Snow Time is Joy Time. Y.M.C.A. 1 reel, free; California University, rent $.50. Skiing, a winter sport introduced to the world by Norsemen, has become probably Canada's most universally popular winter pastime. The joys and thrills of this form of winter sport in the snow-clad Gatineau Hills adjacent to Ottawa, Canada's capital.

Where Winter Sport is King. California University 1 reel, rent $.50; Y.M.C.A., free; American Museum Natural History, free. Glimpses of the winter sport activities at the historic city of Quebec. This film shows skiing, snow-shoeing, tobogganing and other interesting sports.

Winter in Yosemite. California University 2 reels, rent $1.50. Scenic view of the valley in winter: snow-covered peaks, outdoor ice-rink, hockey game, speed skating, figure skating, ice carnival, tobogganing, ski-joring, Badger Pass, skiing in slow motion, kick-turn, uphill work, down-hill running. Hans Schroll ski running, ski races.

Winter in Yosemite. California University 1 reel, rent $1.00. Tobogganing, riding dog-sleds, figure skating on ice, hockey games, ski-joring races, "ash can" slides. Yosemite's Ice-skating Carnival.

Winter Olympics. California University 1 reel, rent $1.00. Held at Lake Placid in the Adirondacks. Seventeen nations compete for titles in ice-skating races, hockey, figure skating, dog-sled racing, ski-jumping, and bob-sled racing. Famous athletes such as Jaffee, St. Goddard, Rudd, Sonja Henie and the Stevens Brothers.

Winter Sports. Mogull 1 reel, rent $.50. At Lake Placid, White Wings, skiing.

XXIX. WRESTLING

College Grapplers. Gutlohn 16mm., rent $2.00. How collegiate wrestlers are developed.

DIRECTORY OF SOURCES

1. Aetna Casualty and Surety Company, Hartford, Conn.
2. Akin and Bagshaw, Inc., 1425 Williams Street, Denver, Colorado.
3. American College of Surgeons, 40 East Erie Street, Chicago, Ill.
4. American Dental Association, 58 East Washington Street, Chicago, Ill. (Rental $1.00 per day or $3.00 per week plus shipping charges both ways).
5. American Heart Association, Inc., 370 Seventh Avenue, New York, New York (one film).
6. American Medical Association, 531 North Dearborn Street, Chicago, Illinois.

7. American Museum of Natural History (A.M.N.H.) Columbus and 77th Street, New York City. (Borrowers are to pay transportation charges both ways.)
8. American Olympic Committee, 233 Broadway, New York City. ($25.00 rental for any eight films or $4.00 for a single film. A deposit of $25.00 is necessary. Return postage is paid by the renting party, and insurance for $50.00.)
9. American Social Hygiene Association, 50 West 50th Street, New York City.
10. Automobile Club of Southern California, Los Angeles, California. (Loaned in the state. Purchase price given for other states.)
11. Bass Camera Company, 179 Madison Avenue, Chicago, Illinois. (For all rentals outside of the Chicago City limits, add 50 per cent to the base rental charges. Add 50 per cent extra for each day kept over time.)
12. Belgard-Spero, Inc., 30 North Michigan Avenue, Chicago, Illinois.
12a. Bell and Howell Company, 1801 Larchmont Ave., Chicago, Illinois.
13. Borden's Farm Products Company, 110 Hudson Street, New York. (Obtained free of charge with a lecturer within an area of 60 miles of New York City.)
14. Bray Production Inc., 729 Seventh Avenue, New York City. (Pay transportation plus rental.)
15. Burton Holmes Films, 7510 North Ashland Avenue, Chicago, Illinois.
16. Bureau of Visual Education, University of California, Berkeley, California. (Distribution is only in western states, namely, Oregon, Washington, Idaho, New Mexico, Arizona, Nevada, and California.)
17. California State Department of Health, 306 State Building, Bureau of Child Hygiene, San Francisco, California. (Films quite old and pertain to the subjects of prenatal care and posture. Films all on 35mm. stock and loaned free of charge except for the transportation.)
18. Capital Film Exchanges, Inc., 843 South Wabash Avenue, Chicago, Illinois.
19. Cereal Soaps Company, 334 East 27th Street, New York City. (Free except for transportation.)
20. Chicago Park Department, Chicago, Illinois.
21. Conboy, Dr. Fred, 1043 Bloor Street, Toronto, Canada. (Recommended by the American Dental Association.)
22. Connecticut Dairy and Food Council, 43 Farmington Avenue, Hartford, Conn. (Free except for return postage.)
23. Coward Shoe Company, 270 Greenwich Street, New York City. (Films offered free to adult audiences in New York.)
24. DeVry, Herman A., Inc., 1111 Center Street, Chicago, Illinois. (Sell films $24.00 per reel with discount to full lesson groups.)
25. Eastman Teaching Films, 343 State Street, Rochester, New York.
26. Edited Pictures System, Inc., 330 West 42nd Street, New York City.
27. Erpi Picture Consultants, 250 West 50th Street, New York City. (10 per cent educational discount on all purchases by schools.)
28. F. C. Pictures Corporation, 505 Pearl Street, Buffalo, New York. (35mm. stock and available for rental at $3.00 each.)
29. Field and Stream, 578 Madison Avenue, New York City.
30. Films, Incorporated, 330 West 42nd Street, New York City.
31. Films of Commerce, 35 West 45th Street, New York City.
32. Fireman's Fund Indemnity Company, 116 John Street, New York City. (One free film.)
33. Fisher Body Division, General Motors Corporation, Detroit, Mich.
34. Fones, Alfred C., 10 Washington Street, Bridgeport, Connecticut. (Recommended by American Dental Association.)
35. Fogg, May, Chairman of the United States Field Hockey Association, Sargent College, 6 Everett Street, Cambridge, Mass.
36. Garrison Film Distributors Inc., 729 Seventh Avenue, New York City. (Dealers receive a discount on purchase price of films.)

37. Gaumont British Picture Corporation of America, 1600 Broadway, New York City.
38. General Electric Company, 1 River Road, Schenectady, New York. (Free except for transportation.)
39. General Foods Corporation, 250 Park Avenue, New York City.
40. Gutlohn, Walter O., 35 West 45th Street, New York City. (Rental rates do not include transportation charges. 10 per cent discount to schools on the sales price.)
41. Harmon Foundation, Inc., 140 Nassau Street, New York City.
42. Hill, David B., D.D.S., First National Bank Building, Salem, Oregon. (Produces one film.)
43. Hudson County Tuberculosis League, Frances B. Fowler, 880 Bergen Avenue, Jersey City, New Jersey. (Available for free use in Hudson County only. Example of service supplied by Tuberculosis Societies all over the United States.)
44. Illinois, State Department of Health, Springfield, Illinois. (State only, so not catalogued.)
45. Institutional Cinema Service, Inc., 130 West 46th Street, New York City.
46. Iowa, University of, Extension Division, University Department of Visual Instruction, Iowa City, Iowa.
47. John Hancock Life Insurance Company, Boston, Mass.
48. Kansas, University of, Bureau of Visual Instruction, Extension Division, Lawrence, Kansas.
49. Kent, Dr. Edwin N., 157 Newbury Street, Boston, Mass.
50. Kodascope Libraries Inc., 35 West 42nd Street, New York City. (Libraries in nineteen cities listed. The prices quoted are for within these cities. 50 per cent of the base rate is added for each day held over in any zone. Add 10 per cent of base rate in first and second postal zones, 25 per cent in third and fourth postal zones, 50 per cent in fifth and sixth postal zones, and 75 per cent in seventh and eighth zones. Transportation is included in the above rates. A minimum charge of $1.50 will be made for any film service rendered.)
51. Libby, McNeill and Libby, Chicago, Ill.
51a. McCrum, Thomas B., 4144 Charlotte Street, Kansas City, Missouri.
52. Loucks and Norling Studios, 245 West 55th Street, New York City. (One seven year old picture.)
53. Maryland, State of (Game Division), 512 Munsey Bldg., Baltimore, Maryland.
54. Mennen Company, Newark, New Jersey. (One film for adult education.)
55. Merrell, Wm. S. Company, Lockland Station, Cincinnati, Ohio.
56. Metropolitan Life Insurance Company, 1 Madison Avenue, New York City. (Films free and transportation paid both ways.)
57. Modern Woodmen of America, Rock Island, Illinois. (One film.)
58. Mogull Brothers, 1933 Boston Road, New York City. (Transportation charge extra. City rentals are quoted for two days on silent films and daily rate on sound films.)
59. Motion Picture Producers, Inc., 28 West 44th Street, New York City.
59a. National Bureau of Casualty and Surety Underwriters, 1 Park Avenue, N.Y.C.
60. National Dairy Council, 111 North Canal Street, Chicago, Illinois.
61. National Motion Picture Company, Mooresville, Indiana. (25 per cent discount to schools.)
62. National Safety Council, 20 North Wacker Drive, Chicago, Illinois.
63. National Safety Council, 1 Park Avenue, New York City.
64. National Society for the Prevention of Blindness, 50 West 50th Street, New York City. (Only transportation charge.)
64a. National Tuberculosis Association, 50 West 50th Street, New York City.
65. New Jersey State Museum, Mrs. Kathryn B. Greywacz, Curator, Trenton, New Jersey. (Many films free to persons in New Jersey. If located in New Jersey

write for a catalogue of these films, because you will save a great deal as they have a wide collection of the best films. Other states write to State Museums.)

66. New Jersey Tuberculosis League, Inc., 15 East Kinney Street, Newark, New Jersey. (Free for use in state only.)
67. New York Police Academy, New York City.
68. New York State Department of Health, Albany, New York. (Distributed in New York State only—borrower pays the return postage.)
69. Nu-Art Filmco, 145 West 46th Street, New York City.
70. Ohio Congress of Parents and Teachers, Mrs. Emmet C. Stopher, President, 138 North Lincoln, Kent, Ohio. (Recommended by American Dental Association.)
71. Pathe News, Inc., 35 West 45th Street, New York City.
72. Pictorial Film Library, Inc., 130 West 46th Street, New York City. (Referred to by Criterion Films.)
73. Pinkney Film Service, 1028 Forbes Street, Pittsburgh, Pa.
74. Public Welfare Pictures Corporation. (Jewel Productions) 410 East 32nd Street, New York City. (Rental rates furnished on request—judged by the engagement, the time, and length of show desired.)
75. Pyrene Manufacturing Company, Newark, New Jersey.
76. Sheffields Farms Company, 524 West 57th Street, New York City. (Only two films supplied to the Metropolitan area, free.)
77. Smith, Dutch, (Smith Brothers) 1932 Olympic Champions, Palm Springs, Calif.
78. Society for Visual Education (S.V.E.), 327 La Salle Street, Chicago, Illinois.
78a. Syracuse University, Cooperative Film Library, Department of Education, Syracuse, N.Y.
79. Twentieth Century Fox Film Corporation, 444 W. 56th Street, New York City.
80. United States Bureau of Mines, Pittsburgh, Pa.
81. United States Department of Agriculture, Office of Motion Pictures, 1363 C Street, S.W., Washington, D.C. (Transportation charge only expense for free films. Films priced very cheaply for purchase.)
82. United States Department of Labor, Washington, D.C. (No transportation charge.)
83. United States Public Health Service, Treasury Department, Washington, D.C. (Free except for transportation charge.)
84. Warner Brothers, 321 West 44th Street, New York City. (They are compiling a list through the Hays organization, and on completion will send a copy. The film rental will have to be taken up with each particular branch of the organization throughout the United States.)
85. Wheeler, Helena, 55 Hillside Avenue, New Rochelle, New York.
86. Wholesome Films Inc., 48 Melrose Street, Boston, Mass.
87. Willoughbys, 110 West 32nd Street, New York City. (Cash rental rates and also a saving offered by purchasing a coupon book.)
88. Wilson Company, The H. W. The Educational Film Catalogue, 950-972 University Avenue, New York, N. Y.
89. Wisconsin, University of, Bureau of Visual Instruction, University Extension Division, Madison, Wisconsin. (Pay rental and transportation charges one way. Schools in Wisconsin receive a reduction when large numbers of films are ordered. Large number of free films with a packing and transportation charge of $.15 per reel.)
90. Wright and Company, Rockland, Mass. (One medical film.)
91. Y.M.C.A. Motion Picture Bureau, 347 Madison Avenue, New York. (Films listed as free require a $2.00 registration fee each year. Rental fee is minimum charge which usually covers three days not including days in transit. In other cases films may be charged per day with a special rate for three to five days.)

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The Use of a Student Inquiry Form for Evaluating a Course in College Hygiene

By E. F. Van Buskirk
Professor of Hygiene
Stephens College, Columbia, Missouri

INTRODUCTION

THE purpose of this paper is two-fold: first, to describe a method which the writer found helpful in revising a course in college hygiene and which may have value to others who wish to obtain student reactions to their courses; and second, to summarize the findings obtained in the investigation and indicate some of the ways in which they have been used in revising both content and method.

General Nature of the Course.—The course is elective and constitutes the first half of a year's study in hygiene as conducted at a junior college for women. It deals primarily with problems in the field of individual health and is followed by a course in group health. A serious attempt is made to relate the work to the everyday life of the student and to her probable future health needs. The students meet twice a week, once in general lecture and once in small discussion groups.

The major units of study in the order in which they are treated are as follows: (1) explanation of the college health program: (2) a survey of the human body: (3) posture, exercise, and relaxation; (4) air and breathing; (5) foods and digestion; (6) blood and its circulation; (7) excretion and the skin; (8) the nervous system and the sense organs; (9) mental health; and (10) reproduction and sex education. A good deal of illustrative material in the form of motion pictures, lantern slides, models, preparations, charts, etc., is used throughout the course. Notebooks are required of all, objective quizzes are used and every six weeks a short paper is submitted upon supplementary reading.

Methods of Conducting the Investigation.—In January, 1937, at the close of the semester, all of the students were given an inquiry form to fill out.* One hundred and five papers were submitted. The directions which appeared at the top of the first page of the question-

A paper presented before a meeting of the American Association for the Advancement of Science, Section Q (Education), December 1937, Indianapolis.

* Copies of the complete questionnaire may be obtained from the author.

naire were stated as follows: "With a view to improving the course in Personal Hygiene, you are requested to fill out this inquiry form. Your frank opinions will be much appreciated and will aid in planning the course. The papers are not to be signed."

In all there were thirty-one questions. The most important topics were in regard to the content of the course, methods of instruction, practical applications, and critical opinions or estimations. In reporting upon the findings we shall try to limit the presentation to a summary of the answers to the questions on these topics.

THE FINDINGS

Student Reactions to the Content of the Course.—Three questions dealt with opinions regarding comparative values of the different topics studied and possible duplications with high school courses. The students were asked to rate eighteen topics by placing a number in front of each to indicate its value to them: "1" to indicate great value; "2" considerable value: "3" little value, and "4" no value. The average scores for the eighteen topics ranged from 1.38 to 2.29.

The topics listed in the order of their importance, beginning with that considered most valuable and proceeding to the least valuable were: (1) the general significance of sex in human life and the mechanics of reproduction; (2) an introduction to sex education—what should be taught at different ages; (3) personality and the bodily mechanisms concerned; (4) the excretory system together with a study of the care of the skin, hair, and nails: (5) syphilis and gonorrhea; (6) the mechanics of bodily movements, including posture and the care of the feet; (7) exercise and relaxation; (8) disorders of the respiratory system with special reference to colds, tuberculosis, and diphtheria; (9) the emotions in relation to digestion, together with dieting and constipation; (10) the college health program; (11) criteria for judging human conduct; (12) intelligence, feeblemindedness, insanity; (13) the sense organs with special reference to the eyes and their care; (14) common diseases of the digestive system with special reference to cancer, appendicitis, typhoid fever, and dysentery; (15) the mechanics of digestion, including the teeth and their care; (16) the mechanics of circulation, including the heart and its care; (17) the mechanics of breathing and the principles of ventilation; and (18) the sources, composition, and uses of foods.

An examination of the findings regarding the extent to which the course duplicated high school studies revealed that the subjects in which there was a good deal of duplication dealt with foods, bodily movements, circulation, the sense organs, digestion, and breathing. It will be observed that most of these topics were ranked relatively low in value by the students. The topics in which there was little duplication

were: the college health program, criteria for judging human conduct, syphilis and gonorrhea, sex education, the significance of sex in human life, the mechanics of reproduction, and personality. These topics for the most part were considered among the most valuable.

Student Reactions to Methods Employed.—The different methods used in the course were ranked in the following order, beginning with the most valuable and proceeding to the least valuable: discussion periods, lectures, motion pictures, supplementary reading, textual material, notebook work, and quizzes.

Six questions dealt with the use of the library facilities. Thirty-six students stated that they used books other than the textual material frequently, fifty-seven occasionally, ten seldom, and two never. Nineteen said they used magazines frequently, forty-two occasionally, thirty seldom, and fourteen never. Twenty-eight used newspapers frequently, forty-two occasionally, thirty seldom, and fourteen never. Regarding the extent to which the course had led to voluntary reading, thirty-six affirmed that they frequently read about health topics, forty-eight occasionally, seventeen seldom, and two never.

Replying to the question as to the books and magazines which they had used forty-five different titles of books were listed and thirteen magazines. The six books mentioned the greatest number of times were: Palmer and Greenberg's *Facts and Frauds in Women's Hygiene,* Phillip's *Skin Deep,* Kallet and Schlink's *One Hundred Million Guinea Pigs,* Haggard's *Devils, Drugs, and Doctors.* Lane's *Your Carriage, Madam!,* and Clendening's *The Human Body.* The magazines mentioned most frequently were "Hygeia" and "Reader's Digest."

Some Practical Results of the Course.—The questions relating to the practical ways in which they made use of the course afforded opportunity to tell both how the course had helped them and how they had helped others. One of the questions was of a general nature. In answering this question, two stated that the course had been of no value in helping them to benefit from the health facilities of the college, fourteen that it had helped them a little, fifty-seven to a considerable extent, and thirty-eight that they had benefited greatly.

Specifically, they were asked to indicate whether the course had helped them to understand and make use of the following named facilities: the Mantoux testing program, the significance of the physical examination given to all at the beginning of the year, the body grooming program, the prevention of colds, posture and the care of the feet, the dietary program, heating and ventilation methods, and facilities for testing vision. The evidence indicated that the course had functioned along one or more of these lines with the large majority.

General Estimate of the Value of the Course.—Three questions were included for the purpose of securing opinions as to the value of the

course in relation to other courses. Twenty-five stated that it was the most valuable course they were taking, seventy-five that it had average value, three that it was of less value than the average course, and one that it had least value.

Replying to the question as to whether the course should be required of the great majority of students, ninety-nine stated that it should, five said no, and one left this question unanswered. No one thought the course should be discontinued and seventy-six thought it should be given three hours' credit.

USES MADE OF THE DATA

Undoubtedly in many respects the data are open to different interpretations. Certain trends of thinking, however, are apparent and it was for the purpose of obtaining information about such trends that the investigation was conducted.

First, there was abundant evidence to indicate that the students approved of the frank treatment of individual health problems and that they liked to have the emphasis placed upon the practical applications of the study. In several instances it was recommended that topics in the field of reproduction and sex should receive more attention.

Second, the answers to the questions showed that there was clear recognition of the general need of the whole student body for a course which would integrate and make more meaningful the various aspects of the college health program. Some parts of the course were made more functional because of the active cooperation given by the Health Service and by the Departments of Physical Education, Grooming, Psychology, and Dietetics.

Third, the data showed that to a considerable extent the students were applying in practical ways what they had learned. One method of stimulating them to do this was by personal interviews and another was by the use of some functional questions in the quizzes. In addition to those previously mentioned certain other practical results were listed, among which the following appeared: avoiding questionable eating places, discontinuing the use of laxatives, taking more exercise, enrolling in a class of corrective exercises, a changed and more wholesome attitude toward the college Health Service and toward medicine in general, brushing the teeth more carefully, securing and wearing glasses, resuming the eating of breakfasts, wearing more appropriate clothing for cold or stormy weather, and making better use of the siesta hour. (The siesta hour is a period that the college has set aside immediately after lunch for students to remain in their rooms and be quiet.)

Fourth, the answers to certain questions indicated that a considerable number of students were devoting a disproportionately large amount of time to the study of health. Accordingly, as previously stated,

notebook work has been made optional for those enrolled in the ne-hour course.

Fifth, the data seemed to show that certain parts of the course were strong and others weak. An effort is being made to strengthen the weak spots by introducing more illustrative and functional material. Particularly has this been done with the topics treating of foods, digestion, respiration, and circulation, which it will be recalled were rated low by the students.

SUMMARY

The most significant ways in which the data have been used in revising the course have been mentioned. The study made it possible to obtain a clearer idea of both what the course was accomplishing and what it was failing to accomplish. There is, of course, nothing new about the idea of obtaining student reactions to courses. If there has been anything suggestive in this paper as to techniques which others may use as one method of evaluating their courses it will have served its main purpose.

BOOK REVIEWS

REDISCOVERING THE ADOLESCENT — A STUDY OF PERSONALITY DEVELOPMENT IN ADOLESCENT BOYS. Hedley S. Dimock. (New York: The Association Press, 1937), 287 pages, $2.75.

This is a study of the adolescent male in his contacts with his daily environment, and of the changes that occur in the adolescent behavior as he passes from childhood into pubescence. The adolescent is "newly discovered" in this research in that the findings are frequently in contradiction with "what everyone knows."

The approach to the problem is unusual in that a study of the cross-section of a given group is avoided by studying a group of 200 boys as it grows into adolescence. The subjects are from Kenosha and Milwaukee. They were observed in many types of situations (such as clubs, camps, play groups, etc.) by trained observers and were regularly interviewed and tested by standardized techniques. They ranged from 12 to 14 at the beginning of the study and from 14 to 16 at the end of the two-year data-collecting period.

Dry and detailed tables have been avoided by the substitution of pictograph symbols cleverly designed by Harold Haydon. These breezy pictures of the findings handsomely summarize the text. The book is an account of a scientific study but in this edition the serious thoughts are approached lightly enough to allow the volume to be of value to parents and any others who are likely to be unwilling to wade through technical verbiage. The research minded person will find the detailed statistics and technical phases of the project included in a monograph entitled "A Research in Adolescence," published by the Society for Research in Child Development.

It is regretted that this study deals only with males. A repetition of this technique for the girl is now needed to complete the picture, in so far as a study of adolescents, without including the attitude toward the opposite sex, is possible. An application of Mr. Dimock's procedures to a mixed group is needed. Despite the fact that economic insecurity seems to be a big bugaboo for today's adolescent, this problem is completely omitted.

This study is a true contribution to the scientific work in the field of adolescence because the author has continually observed a large group of persons while they are passing through a critical phase in their development and because he has cautiously evaluated his hypotheses before applying them to practical situations.

ALVIN F. ZANDER
Kellogg Foundation Research Fellow, Battle Creek, Michigan

THE CONDUCT OF PHYSICAL EDUCATION. Mabel Lee. (New York: A. S. Barnes and Company, 1937), 561 pp.

Miss Lee's timely volume holds for the teacher of physical education a valuable compendium of information, presented against a background of sound philosophy and of sterling professional ethics. The scope and variety of the subjects treated would alone make the book noteworthy; the young teacher will find therein answers to the "What, How, Why, Where, and When" of physical education, and the school

executive is given workable suggestions for organization and administration. Those who use the volume will bless the author for copious annotations and bibliography; these go far toward presenting a comprehensive survey of current literature in physical education. In discussing possible controversial topics, Miss Lee presents conflicting authorities and their conclusions with fine detachment and impartiality.

A cursory glance at *The Conduct of Physical Education* gives one the impression of needless duplication of material; a closer study of the book convinces the reader that on the contrary, the reiteration adds to the usefulness of the volume as a teaching manual.

The style is crisp and forceful, and the conclusions are presented with clarity and effectiveness. Miss Lee has dedicated her book to Amy Morris Homans; the offering would have been thoroughly approved by that fine and critical pioneering spirit.

MARY CHANNING COLEMAN,
Woman's College, University of North Carolina.

A MEASUREMENT OF THE ACHIEVEMENT IN MOTOR SKILLS OF COLLEGE MEN IN THE GAME SITUATION OF BASKETBALL. Glen W. Howard, Ph.D. (New York: Bureau of Publications, Teachers College, Columbia University. No. 733, 1937), 109 pages, $1.60.

Evidence is presented in this thesis to show that the achievement of college men may be measured objectively while actively participating in a game of basketball. The data include observations of four groups of players: (1) the eight teams who tried out for Olympic basketball in the spring of 1936, making a total of fifty-one players in this group; (2) the players on sixteen teams engaged in inter-collegiate and inter-club competition in eastern colleges, composed of seventy-one men; (3) the regular classes in physical education of Seth Low Junior College; (4) The Ohio State University varsity and freshman teams.

The method of study was purely observational on the part of the author and college students on the varsity basketball team. "Two methods of timing were tried. The first method required that the observation be recorded, and the time taken, during moments in which the ball was in the offensive area only, regardless of the team being observed. . . .

"The second method tried and used for all observations reported here, except one, was to record play on any part of the court . . . The observers agreed that the second method was easier to use than the first."

The observational periods were two and one-half minutes of actual playing time.

The following conclusions have been drawn from this study: (1) a technique has been developed to measure achievement of college basketball players actively participating; (2) the validity and reliability of the observational test compare favorably with skill type tests; (3) the number of successes achieved by the player during six periods of observation is a valid measure of the player's achievement in the game; (4) this technique may be applied to other games for which this type of test is not now available.

The findings should be of value to the teacher or coach interested in measuring achievement of players, as well as to people in research, working on construction of tests and measures in game situations, rather than isolated achievements in game fundamentals.

JOHN EDGAR CASWELL
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PREFACE

At no time in the development of professional preparation for teaching health and physical education has there been a greater need for reflective thinking, intensive study, and intelligently guided experience in research. Not only is it necessary to have wisdom for the proper use of a rather bewildering array of experimental and statistical techniques, but also to be able to devise new equipment and procedures as the need arises.

The ninety-six special studies reported in this volume have, with a few exceptions, been offered in partial fulfillment of the requirements for the M.S. degree at Wellesley College. Most of them have been completed under the direction of Dr. Eugene C. Howe, whose insight into the problems of research and whose technical skill in devising the practical details of the equipment used in many of these studies have enabled our graduate students to have an experience usually reserved for candidates for more advanced degrees.

Recognition for the work herein reported should go first of all to the student authors, and also to those members of the staff who contributed information and suggestions in the fields of administration, dance, orthopedics, and sports. To the many students who served as subjects, grateful appreciation is extended.

Since 1929 Miss Elizabeth Powell has been closely associated with Dr. Howe in the development of the research program and in the editing of thesis manuscripts. It is largely through her efforts that this summary of department research projects has been prepared.

RUTH ELLIOTT

Chairman of the Graduate Department of Hygiene and Physical Education, Wellesley College.

FOREWORD

The teacher of to-day, if he is to attain his full effectiveness, should be a cultivated, educated individual with resourcefulness, self-confidence, initiative, and the power of independent thought which begins where the trail-breaking textbook leaves off. Progress in the profession would indeed be slow if those engaged in it were only "trained" in the skillful following of directions.

To be responsible for some major research or quasi-research project, under a reasonable amount of guidance, but without too much faculty predirection and predigestion, is an experience which any student has a right to demand for his own education, toward the attainment, eventually, of a respectable scholarly stature. Not every student is by temperament or ability capable of research. Not every student on the M.S. level can expect to succeed fully in contributing to the "expansion of knowledge." This is no reflection. All have their gifts, some for pioneering, some for application. But each is entitled to have the experience of making the attempt for the sake of his own personal growth.

The following abstracts, then, should be regarded from two points of view. They reflect the working out of a consistent program of theory and practice in the professional preparation of teachers. They contribute in some degree to the advancement of knowledge in our field, and to the arrangement of already known facts into relationships which are practically serviceable at the moment for the running of the school machine. It is to be noted that much more often than not, "theoretical" research turns out to be, in the long run, the more importantly practical.

The text for this Supplement to the RESEARCH QUARTERLY has been transcribed by members of the faculty rather than by the students themselves because in this way it was possible to present a more coherent account of the work as a whole. In the space which is available to us, it has not been possible to include much of the data and discussion leading up to summaries and conclusions. For these the reader is referred to the original reports which are on file in the department library, and to special articles which have been published from time to time.

ELIZABETH POWELL
EUGENE C. HOWE

WELLESLEY COLLEGE
February, 1938

Objectives and Student Interests in Physical Education

ADVANCED study and research in physical education rightly begins and ends with philosophical considerations—what the professionally trained leader thinks of physical education, and what the ultimate consumer thinks of it. Sometimes it seems that there is an insufficient amount of philosophical guidance for rapidly developing administrative and teaching procedures and for research programs.

Constance Nelson's "Analysis of the Trend in Objectives of Physical Education in the United States" (1933) is more than its title implies. The study includes a very able analysis of modern objectives, and the formulation of special objectives for college women.

The amount of interest in physical objectives and that in tests and measurements was judged by the amount of printed space devoted to these subjects in the *American Physical Education Review* from 1896 to 1929. During this time 13.6 per cent of the articles and 3.8 per cent of the pages were concerned with the subject of objectives. The corresponding figures for tests and measurements were 12.0 per cent of the articles and 7.0 per cent of the pages.

The trends of interest were judged on the basis of subtotals for consecutive six-year periods. Except between 1896 and 1901, when particular emphasis was placed upon objectives, there was no significant variation—about 12 per cent of the articles being upon this subject. During the same period the number of articles on tests and measurements decreased from 16.8 per cent between 1896 and 1901 to 4.7 per cent in the 1914–19 period, then rose rapidly to 19.8 per cent in the 1926–29 period.

When extensive claims for physical education were questioned, physical educators were apparently stimulated to devise and apply tests and measurements to the outcomes of their programs in order to validate their claims. The increasing interest in the tests and measurement program, in turn, affected the statement of objectives by causing a movement toward more conservative claims.

The relative ranking of objectives and of specific elements in the testing program was based upon the frequency of mention in the *A.P.E.R.* during the same period—between 1896 and 1929. Each objective was analyzed through the context of the article in which it appeared, and then classified under the heading which best seemed to cover its implication.

From 1896 through 1919, organic development was considered of prime importance; from then on, character development was the most

emphasized objective, with organic development taking second place. Motor development, with the exception of the years from 1902 to 1907, occupied third rank. Functional and anthropometric measurements occupied top ranks with the exception of the 1920–25 period when they were surpassed by tests of athletic ability and physical efficiency.

The status of modern objectives of physical education was determined through a critical survey of literature in the field from 1920 to 1933. Most writers agree to two main divisions: the administrative objectives which deal with certain standards desired for the environment in which the activities take place; and the educational objectives which deal with the desired outcomes of the program.

As in all education, both pupil and teacher objectives can be recognized. During childhood and early adolescence, joy and satisfaction in participation are the chief pupil objectives (as will be shown by von Lewinski and Butsch, p. 8). It is important that teacher and pupil objectives are mutually understood. At least on the college level, the students not only are able to grasp teacher objectives, but they are interested in knowing what objectives have been set up for their program. Conversely, it is evident that success in teaching physical education depends partly upon the recognition of pupil objectives.

The ranking of teacher objectives, based on frequency of mention in a carefully selected bibliography, gives first place to character development and second place to organic development. Then follow neuromuscular development, preparation for leisure time, development of appreciations, posture, and the correction of physical defects.

The character training objective of physical education centers around such qualities as cooperation, tolerance, sportsmanship, honesty, loyalty, and persistence in the face of difficulties. The learning process here is as in all learning. The individual must be given a concept of the desired character trait. Then he must have opportunities to make suitable responses as he participates in the various activities. Much depends upon the kind of leadership provided; desirable traits are not inherently associated with the physical education activities, per se.

Organic development—increasing the functional powers of the various systems of the body—results from suitable muscular activity. An important approach to health in physical education is through the big-muscle activities which make for organic development. Muscular contractions affect bony growth, metabolic function, excretion, circulation, respiration, and the entire nervous system. In the life of the average person today the natural incidental opportunities for organic development are insufficient, hence it is necessary to provide suitable and systematic opportunities through programs of physical education.

Neuromuscular development per se has an important and unique contribution to make in teaching individuals the fundamentals of movement and providing a basis for the acquisition of the finer manual skills.

Beginning with such fundamental skills as running, jumping, and throwing, neural patterns which are basic to the race are strengthened and elaborated at the same time that the associated muscles are developed. The combined result gives skill and strength; the extent to which these elements are harmoniously developed determines the degree to which the body is physically educated. All thought must be directly or indirectly expressed in action. The more adequately the individual can express himself, the more satisfaction he will derive, and the greater will be the psychological benefits accruing from having met the situation successfully. The proper handling of the body is essential also from the point of view of safety.

The provision for leisure-time activities may not be a direct responsibility for physical education alone. However, physical education has an easy approach to the problem since it offers activity which appeals to the majority and has few unwholesome aspects.

Those concomitant learnings which come under the head of cultural appreciations take place, or should take place, at the same time that an activity skill is being learned. This type of learning is important because it often determines the effectiveness of the carry-over of the activity. The appreciations which can be developed through physical education are varied. Among them are the appreciation of play and physical activity as a factor in health and vitality, also the appreciation of the beauty in form, line, movement, and rhythm.

Physical education presents many opportunities for intellectual development since its program contains activities to be learned and problems to be solved. The special contribution which physical education has to make to intellectual training lies in the development of strategic judgment. Success in physical activity frequently demands that decisive action be taken immediately.

Erect posture has always had a place in the list of physical education objectives because it favors optimum functioning of the body, possesses social and economic values, and has a definite relation to mental attitudes. Some physical educators regard posture as a by-product which results from body development. There are others, however, who regard it as a specific skill which must be learned, just as the specific skills required in tennis or golf must be learned.

The detection and correction of remediable physical defects occupies a relatively less prominent place in physical education today than formerly because of the increasing emphasis upon the developmental side of the program. The need for corrective physical education is apparent from medical records and from the observations of laymen. In many cases the correction of defects must precede organic and neuromotor development.

As physical education has become an accepted phase of general education, the former has adopted the objectives of the latter. There

is some danger of emphasizing those values to which physical education is only a contributor, and neglecting those values which are found chiefly in the physical education program. Nelson believes that if it is necessary to curtail what might be considered an ideal physical education program, the three objectives that should be stressed are organic and neuromuscular development and the acquisition of suitable leisure-time activity skills.

After stating the fundamental objectives of physical education in general, Nelson analyzed those needs of college women to which the physical education program can contribute and listed objectives for this student group as follows:

1. An understanding of the principles of body mechanics, experience in the kinesthetic sensations which accompany "good form," and development of those skills which are basic to all body movement.
2. Acquisition of those social values which can be developed through individual sports, organized team games, and social dancing.
3. Development of the intellectual and unhesitant use of the various body skills as methods of response.
4. Development of such physical qualities as strength and endurance through all-round body activity.
5. Correction of those structural and functional body defects which lie within the limits of a physical education program of activity and rest. Many students need release from muscular hypertension.
6. Experience in cooperation, acknowledgment of the legally determined rights of others, and sociable relationships with others through group activity (particularly in team sports).

It is interesting to see that the writer of this philosophical thesis has recently published an article entitled "The Case for Gymnastics" (*Journal of Health and Physical Education,* December, 1937) in which she reports her experiences in teaching elementary and secondary school chidren. Her thoughtful evaluation of methods and material in physical education is an example of how so-called "theory" may be applied to practical, everyday problems.

Inge von Lewinski's questionnaire study entitled "Student Interests and Attitudes Concerning Physical Education" (1933) has already been reported at some length (*Research Quarterly,* March, 1937). A parallel study by Margaret Butsch ("Further Studies in Student Interests and Attitudes Concerning Physical Education Activities at Wellesley College") was made in 1937 to ascertain the interests and attitudes of the next college generation, especially since a number of changes had been made in the curriculum and administrative procedures in the undergraduate courses of this department where these questionnaire studies were carried on.

Both von Lewinski and Butsch found that individual sports are preferred to team sports. The main reasons for choosing sports they

"would like to take" were enjoyment and the desire to gain in skill. The reasons for saying that they "ought to take" sports were that the activity was a social asset, was both necessary and useful, and provided exercise.

The fact that fencing and badminton are now offered in the winter season seems to account, partly at least, for the relatively greater number of votes for indoor sports as compared to rhythmic activities under the heading of "would like to take." However, modern dance again heads the list of winter activities "I think I ought to take." In this list swimming, social dancing, apparatus work, fencing, gymnastics, basketball, tap dancing, and badminton (in that order) took precedence over a long list of minor indoor sports. The chief benefits are thought to be increased grace and poise, coordination, motor control, and posture improvement.

Activities receiving a more favorable reaction in 1937 than in 1933 from students enrolled for credit were lacrosse, archery, folk dancing, individual gymnastics, tennis, group gymnastics, volleyball, and restricted activities. The newly offered fencing and badminton received the highest approval ratios with lacrosse and crew coming next in order.

The 1937 reaction to the gymnastic and sports program, the requirement in physical education, and the motor ability test was very similar to that in 1933. Eighty-five per cent of the students feel that physical education should be a required part of the college curriculum. An increase in strength and endurance is desired by 81 per cent. If additional recreation facilities were available 76 per cent of the students said they would use them occasionally, especially between the hours of three and six in the afternoon. Provision for such recreational use of the department facilities will be more possible upon the completion of our new swimming pool and recreation building.

Further curricular progress is being stimulated and guided by the findings of the Butsch questionnaire. The suggestion has been made that such a study as hers be made every four years, also that further inquiry might be made into student objectives of physical education and into ways of integrating these with the more mature objectives of the instructor and of the department as a whole.

Physical Fitness and Endurance

SINCE organic development has been accepted as one of the primary objectives of physical education, it becomes important to investigate the factors that enable the human body to continue muscular work and postpone the onset of fatigue. From a review of the literature it appears that endurance is related principally to circulatory and respiratory efficiency, to the state of nutrition, and to the "training" of the individual. Both physical and chemical processes are involved in determining the rate at which food and oxygen may be supplied to the tissues and the waste products removed.

Tests of endurance have developed along several lines. First of all are the performance tests in which the subject accomplishes a certain amount of external work. The amount of work and its duration are taken as measures of endurance. Second are the tests of heart rate and blood pressure under various circumstances. A third approach is through the study of alkali reserve and hemoglobin and a fourth through metabolism tests. Each aspect of the subject seems to have something to contribute to our understanding of endurance.

The various Wellesley College thesis studies on this subject are concerned mostly with cardiovascular and metabolism tests as can be seen from the following list of titles:

A study of the Factors of Physical Endurance, Anna S. Espenschade '26.

Alkali Reserve and Hemoglobin as Factors in Fitness, Miriam W. Taylor '28.

A Cardiovascular Test of Fitness, Margaret S. Poley '30.

A Study of Venous Pressure and Pulse Rates in Relation to Endurance and Motor Ability, Dorothy A. DeVries '31.

A Study of Various Cardiovascular Tests, Elizabeth Circle '32.

The Validation of Functional Measurements of Endurance, Marjorie P. Phillips '35.

The "Physiological Cost" of Some of the Activities Used in Physical Education, Josephine L. Rathbone '23.

The "Metabolic Cost" of a Standard Exercise: A Study of Women Subjects of Various Ages, Training, and Habits of Living, Vivian D. Collins '23.

A Laboratory Basal Metabolism Apparatus, Julia R. Grout '28.

A Study of the Relation of Oxygen Debt to Endurance, Helen L. Fredrickson '32.

A Study of the Reliability of Oxygen Debt Determinations, Dorothy Jane Adair '33.

A Study of the Reliability of Maximum Oxygen Debt Determinations, Alma V. Wyche '35.

The Relation Between Oxygen Debt and Athletic Endurance, Mary Yeaton '36.

Mathematical Analysis of the Rate of Payment of Oxygen Debt after Vigorous Exercise, Doris Snodgrass '36.

A Further Study of the Relation Between Oxygen Debt and Athletic Endurance, Helen L. Russell '37.

A Study of the Reliability of Oxygen Debt Determinations with Shortened Preliminary Rest Periods, Elaine M. Dear '37.

Espenschade (1926) studied the effect of exercise upon heart rate and blood pressure. On account of the possibility of danger to untrained individuals, it was, of course, inadvisable to use such an exercise as the mile run or middle distances as the performance criterion. The alternative was to offer a test of severe activity for a very limited period of time and attempt to predict, from the subject's reaction to the short exercise, her status of endurance in general, and physical fitness so far as this depends upon endurance.

The exercise selected by Espenschade was running up and down a flight of twelve steps until five round trips had been completed. The time for each lap of this race was recorded by means of a key struck by the subject at the beginning of the test and at the end of each round trip, a signal magnet, and Jaquet time marker on a revolving drum. The standing pulse of each subject was taken before the exercise and at fifteen second intervals following it until the rate returned to normal.

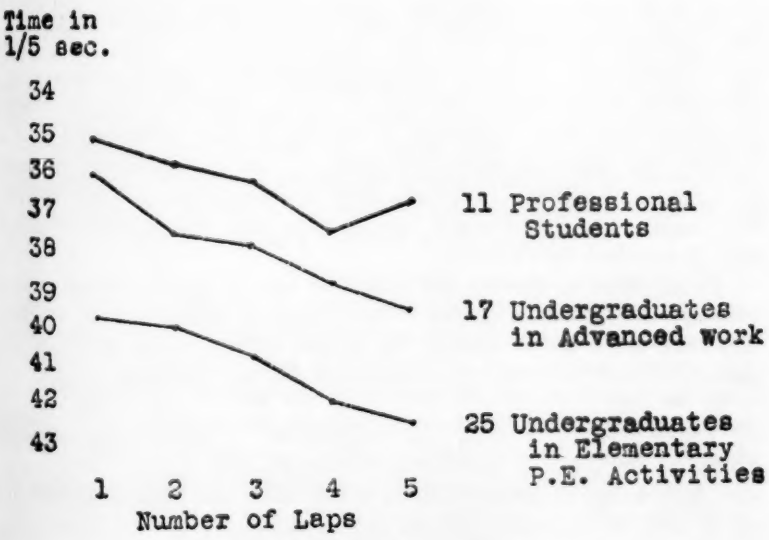

FIG. I. Speed Records on Stairs Test

The test was given to fifty-three students representing three distinct groups with regard to training and ability. The average time required by each group for the five laps was found, and the results plotted in Fig. I. The well trained group not only made better time than the others on each lap, but they were able to "spurt" for the final trip.

A consideration of increase in heart rate presents a very different picture: the elementary activity group showed a smaller increase than the other two. This indicates that those students were not doing their best, or that some protective mechanism limited their speed. In order to throw more light on the problem, the subjects' pulse rates were taken before and after a standard exercise (stepping up on a chair forty times in a minute). This time the professional group showed the smallest increase and lessened its increase by twenty beats per minute, whereas the elementary group lessened its increase by only four beats. Since the increase in heart rate for this group is so nearly the same for both tests, it is likely that they did exert themselves up to the point where their speed was limited by a lack of cardiovascular efficiency. The pulse rate data in beats per minute are summarized as follows:

Endurance Rating	Before Exercise		After Exercise		Increase	
	Stairs	Chair	Stairs	Chair	Stairs	Chair
Good	84	76	144	116	60	40
Medium	88	92	152	140	64	48
Poor	94	100	146	148	52	48

A high degree of correlation was found to exist between the stairs test and the Schneider test, the coefficient being $.78 \pm .018$. There were several cases in which the subject had good Schneider scores but poor scores on the stairs test. The chair test indicates that these subjects were not doing their best on the stairs test. There were also a few subjects who had unusually good records on the stairs test and poor Schneider scores. If a choice must be made between the Schneider and stairs test, Espenschade recommends that the non-performance test (Schneider) be chosen.

In an effort to shorten the Schneider test, a correlation was made between the Schneider scores of four hundred miscellaneous subjects and these same scores without the points given for the return of the pulse rate after exercise. A coefficient of .89 was obtained.

Taylor (1928) studied the possibilities of determining physical fitness on the basis of Marriott's test for alveolar carbon dioxide tension, percentage of hemoglobin as shown with the Dare hemoglobinometer, and the Schneider test. As can be seen from the following table,

students in excellent, good, fair, and poor physical condition could be clearly distinguished on the basis of these tests.

Instructor's Estimate of Condition	Schneider Score	Carbon Dioxide Tension	Percentage Hemoglobin	Triple Score (Weighted)
Excellent (10 cases)	13.00	43.50	86.20	52.2
Good (20 cases)	11.85	40.64	85.50	46.5
Fair (20 cases)	10.05	37.25	82.15	33.1
Poor (10 cases)	8.10	34.75	78.50	21.7

In the Marriott test a sample of alveolar air is obtained by rebreathing over a period of twenty seconds about six hundred cubic centimeters of air from a rubber bag. This air is then bubbled into an indicator solution containing sodium bicarbonate. The sample is compared with standards made up with certain known tensions of carbon dioxide.

Since the carbon dioxide tension of alveolar air is nearly identical with that in venous blood, it is supposed to be, therefore, a satisfactory indirect measure of the alkali reserve of the blood. This alkali reserve chiefly in the form of sodium bicarbonate and hemoglobin plays an important role in maintaining the normal hydrogen ion concentration of the blood. During exercise large quantities of lactic acid are produced and reach the circulation. As long as the buffer substances can keep the hydrogen ion concentration down to normal, the exercise may continue and fatigue is postponed. The function of hemoglobin as an oxygen carrier is, of course, well known. The carbon dioxide tension and hemoglobin tests are therefore sound from the point of view of fundamental physiology. Taylor's correlation coefficient of .71 between the Marriott and Schneider scores is indirect evidence of the validity of this alkali reserve test as a measure of endurance.

Poley (1930) worked with pulse rates and blood pressures, attempting to meet some of the objections to the Schneider test, especially with reference to the method of scoring. She also studied the effect of positions in which the head was lower than the feet, and tried out three different types of standard exercise. Twenty-five of her subjects were medically restricted because of minor cardiac defects, twenty-five were major students in the Department of Hygiene and Physical Education, and fifty were taken at random from the freshman gymnasium classes. No new items proved superior to those suggested by Schneider, and the Schneider exercise of stepping up on a chair five times in fifteen seconds

was on the whole more satisfactory than downward bending or running in place. Correlations with medical ratings and instructor's grades of condition were as follows:

Test Items	Medical Grade	Instructor's Grade
Standing pulse rate	.485	.310
Reclining pulse rate	.369	.334
Pulse rate increase on standing	.337	.130
Pulse return after exercise	.434	.254

Pulse increase on exercise and systolic pressure readings showed no significant correlation with the criteria.

In building up a regression equation for predicting endurance as measured by the medical ratings, Poley chose reclining pulse, pulse increase on standing, and pulse return after exercise, and obtained a multiple correlation coefficient of .646. When standing pulse was substituted for reclining pulse, the multiple was raised to .658. Since the correlation between standing and reclining pulse rates was high (.844), it was unnecessary to use both these values in building up a regression equation.

When the various cardiovascular tests were scored according to the Schneider tables, the results correlated only .517 with the medical ratings. By comparing the predictive indices of the Schneider scores with those obtained from the reclining pulse regression, the latter were found to be superior by 63 per cent. In other words, the statistical technique of finding an optimum weighting for three items (reclining pulse, increase on standing, and pulse return after exercise) gave better results than the use of the Schneider scoring table and a larger number of items.

These findings are not as important as they first appear because the medical ratings depended partly upon pulse rate determination before and after exercise—this criterion and the test items were not independent and the resulting zero order correlations are spuriously high. The correlations with instructor's ratings are not open to this objection.

It was suggested that this line of work be continued with special emphasis upon getting a stronger criterion and a more precise method of determining the time required for the return of the pulse to normal after exercise. The possibility of using a graphic tambour record and stroboscopic disc was mentioned.

The significance of venous pressure determinations as possible factors in endurance was studied by DeVries in 1931. She also continued with the study of pulse rates and attempted to establish a satisfactory criterion of endurance.

Venous pressure was measured by applying external pressure to a small area of the skin over a superficial vein, and noting the point of collapse. The various cardiovascular tests and an endurance run were given to a random sample of one hundred undergraduates. This sample was quite different from Poley's group who were selected on the basis of apparent good and poor endurance. On an a priori basis, smaller coefficients of correlation with any endurance criterion would be expected, but the findings would be applicable to the conditions of routine testing.

The cardiovascular tests were all given between the hours of two and five o'clock on afternoons when the subjects had had no previous gymnasium work. The testing conditions were far from ideal, however, because other somewhat disturbing tests were being conducted in the same laboratory.

The score in the endurance run was the number of laps the individual could run, at a controlled pace, before becoming too fatigued to run any more comfortably. The pace was set by the operator who manipulated a marker on a rope stretched between two bicycle wheels 87 feet apart. The marker travelled back and forth as the drive wheel was turned at a given speed. The number of laps covered ranged from 7 to 56 with an average of 18.5.

Apparently none of the cardiovascular tests correlated significantly with the endurance run criterion. The highest coefficient (—.252) was obtained with the pulse rate increase on standing. The next highest was the coefficient of .117 with reclining pulse rate. DeVries gives three possible explanations for these results:

1. The circumstances under which the cardiovascular measurements were given may have increased the latter's unreliability beyond permissible limits. If the test had been successful under such conditions it would have been a certain indication that it would be of practical use in the schools and colleges where ideal test conditions are seldom found.

2. The objective criterion of endurance may have measured interest, determination, and attitude rather than the physical factors it was designed to measure.

3. The achievement of a cardiovascular test to differentiate between individuals all of whom are above a given standard of fitness from a medical point of view may be impossible in terms of the conventional pulse rate and blood pressure measurements that have been used heretofore in the attempt to achieve such a test.

In regard to the second point, DeVries remarked that most of the subjects appeared to be genuinely interested in the project and cooperated fully in following directions as to the "end point" of performance.

DeVries reported the findings of laboratory experiments in applied physiology (Course 321) which have some bearing on her major prob-

lem of validating cardiovascular tests. The twenty members of the class took the endurance run, the flarimeter test (duration of blow after standard exercise), and were tested for alkali reserve, hemoglobin, and pulse rates (scored according to the Poley regression). Rank order correlations with the endurance run were as follows:

Alkali reserve	.135	Duration of blow	.157
Hemoglobin	.157	Poley regression	.369

These coefficients may be spuriously small because the subjects were all in good condition and much more homogeneous with respect to endurance than an unselected sample of non-professional undergraduates. Further work with a larger group was therefore recommended.

Circle (1932) continued the study of cardiovascular tests. Her apparatus was set up in a small quiet laboratory. She worked first upon a group of forty-five undergraduates, then upon a group of 100, and finally upon three professional students in an effort to establish the validity and reliability of a long list of cardiovascular tests. Several criteria of endurance were tried.

For the group of forty-five, the scores obtained from a jumping jack endurance exercise were correlated with scores for hemoglobin, alkali reserve, length of blow on the flarimeter, pulse pressure, pulse return after exercise, systolic and diastolic blood pressure, pulse difference between lying and standing, and venous pressure difference. The largest coefficient was .088, which under no circumstances could be considered significant.

The results for the group of 100 subjects was slightly less discouraging, possibly because of the increased skill of the operator and the use of other criteria of endurance. The flarimeter test for length of blow was chosen as the best single measure of cardiovascular efficiency. Pulse pressure, pulse return after exercise, and alkali reserve showed small and not very consistent degrees of relation to various criteria. Since the coefficients of intercorrelation were sometimes larger than the correlations with the criteria, it was useless to try to build up a regression in which several of these factors were combined.

In the reliability study six tests were made on each of three subjects. The hemoglobin and flarimeter tests were least variable, the venous pressure scores most variable, as might have been expected on the basis of these few tests, but apparently individual and diurnal variations are just about as great as variation among individuals. This is notably true of alkali reserve and pulse pressure scores, but not of hemoglobin, flarimeter, and systolic blood pressure scores.

Another attempt to validate cardiovascular tests was made by Phillips in 1935. Fifteen professional students and fifty undergraduates served as subjects. The subjects pedalled at top speed for one minute

on the stationary bicycle which was adjusted so as to offer a brake resistance of twelve pounds. The number of revolutions made the first thirty seconds and the number made the second thirty seconds were counted and recorded. The difference between these two scores was chosen to be the validation criterion since it seemed to measure the sustained effort of which an individual was capable during maximum exertion.

The results were much better on the whole than Circle's, but the coefficients for the graduate and undergraduate groups showed unexpectedly large variations as can be seen from the following table:

Correlation with Bicycle Criterion	Graduates		Undergraduates	
	r	P.E.	*r*	P.E.
Heart rate reclining	.478	.13	.247	.089
Systolic pressure reclining	.332	.15	.227	.090
Diastolic pressure reclining	—.321	.15	.123	.094
Heart rate standing	.683	.09	.236	.090
Systolic pressure standing	.231	.16	.165	.093
Diastolic pressure standing	—.363	.15	.099	.094
Heart rate change on standing	.391	.15	—.209	.091
Diastolic change on standing	.018	.17	.002	.095
Heart rate after exercise	.369	.15	.185	.092
Heart rate increase after exercise	—.007	.17	.067	.095
Heart rate return to normal	.089	.17	.097	.095
Alkali reserve	—.057	.17	.090	.094
Vital capacity	.224	.16	.139	.094

In discussing the endurance criterion, Phillips calls attention to the fact that the graduate group made a better average score in the first thirty seconds and a lower score in the last thirty seconds than the undergraduates. The latter were better able to maintain speed because they started at a lower level. The implication from this is that the difference between the scores made in the two thirty second periods depends more or less upon the amount of work done during the first period. Upon correlating the endurance criterion with the number of revolutions in the first thirty seconds, coefficients of .714 and .500 were obtained for graduates and undergraduates respectively.

When the total number of revolutions was used as the criterion, the correlation coefficients for the graduate data looked rather promising. But when they are compared with those for the undergraduates, the utter lack of parallel results indicates that cardiovascular tests cannot be depended upon as measures of endurance for medically unrestricted college students.

The "physiological cost" of muscular exercise may be determined by measuring the amount of oxygen consumed or carbon dioxide produced. Obviously some physical education activities use up more fuel than others and make greater demands upon the cardiovascular mech-

anism. Conversely "physical training" increases not only the individual's capacity for work, but also his efficiency in performance, i.e., more external work can be performed per unit of fuel used.

Rathbone obtained measures of the gross "physiological cost" of fourteen different kinds of exercises by means of a series of experiments with a Douglas bag and Haldane gas analyzer. The cost of the exercise was computed in calories per kilogram of body weight per hour. A series of seven exercises with one subject gave the following results:

"Pussy-cat"—dramatic dance for young children	4.55
Gymnastic lesson performed with definiteness	4.69
Rhythmically stepping up on chair (15 times per min.)	6.44
Non-definite gymnastic lesson	7.75
Strenuous folk dance (Brahms' Fifth Hungarian Rhapsody)	8.12
Going up and down stairs (120 steps per minute)	8.57
Vigorous hop waltz dance	8.84

Of course it is recognized that the amount of exercise is only one of the many values derived from physical education activities and that this factor should not enter too heavily into the appraisal of any one activity. However, it was interesting to note that range and speed of movement were primarily responsible for the "physiological cost" and that subjective judgments on the vigor of exercise may be faulty. For instance it appeared to the subject that she was working harder during the gymnastic lesson performed with definiteness than when the same exercises were performed non-definitely.

Collins describes an attempt to differentiate among individuals on the basis of oxygen consumption, carbon dioxide elimination, work output, gross efficiency, heart rate, and blood pressure. The "metabolic cost" of her standard exercise varied between 3.24 and 6.14 calories per kilogram of body weight per hour, with an average of 4.87. The gross efficiencies varied from 9.1 per cent to 19.8 per cent with an average of approximately 13 per cent. Her test as developed was able to differentiate, with some exceptions, those with either very good or very poor motor ability, but it was not indicative of differences among individuals who were judged to be "in between." The data on oxygen consumption seemed to be more significant than that on carbon dioxide.

Grout started out to study the comparative effect on basal metabolism of a standard moderate muscular exertion in trained and untrained persons. It soon became apparent, however, that such a study demanded a degree of precision in metabolism measurement which none of the short-run, closed-circuit clinical instruments could supply. It was therefore necessary first to develop such an instrument.

The new apparatus was a composite of various well-known types

plus certain original features. The soda lime can was fitted with connections for one way circulation of air. A graphic record of respiration was obtained by means of a pointer attached to one corner of a rocking type (Krogh) float. Oxygen was introduced by water displacement from two-liter flasks. This apparatus was thoroughly calibrated and tested. An average deviation of 2.2 per cent between pairs of consecutive records was obtained. This compares favorably with the 5 per cent precision to be expected from the usual type of apparatus.

Grout then proceeded with her original plan of studying possible changes in metabolism following exercise. In each case the subject was allowed to rest until the pulse rate had returned to normal before the second metabolism test was made. Eight experiments were performed on three graduate professional students. There was an average increase in calories per square meter of body surface per hour of 3.1 per cent.

Fredrickson continued these metabolism experiments on a larger scale and with a little different purpose in mind. Whereas Rathbone and Collins determined the amount of oxygen used during exercise, Fredrickson and her successors in this line of investigation worked with "oxygen debt." This has been defined by A. V. Hill as the amount of oxygen used in excess of the resting level, during the period commencing at the moment exercise ends and ending when the oxygen intake has returned to the resting level. The "physiological cost" is like a down payment; "oxygen debt" is the energy expenditure that is currently not paid for.

The metabolism apparatus had been further improved by using a pair of calibrated burettes instead of the two-liter flasks for introducing oxygen. The standard exercise was stepping in time with a metronome, raising the knee as high as possible at each step. A preliminary group of forty-five subjects and a larger group of one hundred subjects were tested in the afternoon and evening, allowing at least an hour to elapse between the eating of a meal and the taking of the test.

On the basis of A. V. Hill's work it seemed reasonable to expect that oxygen debt scores would be significantly correlated with endurance and cardiovascular functions. There was a wide range in oxygen debt scores among individuals, but these failed to show significant correlation with any available criterion of endurance or with pulse rate scores. The results were somewhat less discouraging with respect to tests for hemoglobin and alkali reserve, the coefficients being —.237 and —.220 respectively.

An inquiry into the reliability of the oxygen debt was made by testing three subjects on four different days under similar conditions, also by testing these same subjects four times a day on two different days. The percentage average deviations for the four different days were 2.4 per cent, 3.8 per cent, and 8.9 per cent; similar figures for

deviations during a single day ranged from .28 per cent to 13.4 per cent.

A more extensive study of the reliability of oxygen debt determinations was made by Adair who tested a group of twenty professional students three times. A special effort was made to give the tests under as nearly the same conditions as possible in respect to room temperature, time of day, amount of activity during the day, hours of sleep the previous night, time of meals, and test procedure. The correlation between tests I and II was .870 $\pm$.079; that between test III (in which the standard exercise on the stationary bicycle was performed at a greater speed) and the average of the first two was .824 $\pm$.086. Upon repeating these tests two years later without attempting to control the conditions mentioned above, Wiggins found a reliability coefficient of only .299 (unpublished report, 1935).

Diurnal variations were studied by Adair. The five subjects were chosen because they had preliminary oxygen debt scores which represented the whole range of obtained scores.Two determinations were made in the morning, two in the afternoon, and one in the evening. All five subjects seemed to vary in the same general manner. There was a fall between the first and second morning scores, a sharp rise between the second morning and first afternoon scores, and then another fall between the two afternoon scores. The changes between the afternoon and evening scores were less consistent. It was apparent that the variations between the standard tests I and II were very small (average 89.2 cc) compared to the diurnal variations (average 305.6 cc).

Obviously the above described methods of determining oxygen debt could not be considered as a practical and immediate means of measuring endurance. However, the theoretical aspects of the subject seemed to warrant further study. For if a metabolism test of some kind could be shown to be a valid measure of endurance, it in turn could be used as criterion in developing more easily administered tests.

Whereas Fredrickson and Adair determined oxygen for a standard exercise, Wyche studied the oxygen debts incurred through maximal exertion. The twenty-one carefully selected subjects took three tests. In the first the bicycle exercise was continued as long as the subject could maintain a speed of 120 revolutions per minute; in the second and third she pedalled at maximum speed for 30 seconds. The return to normal required the use of about twice as many liters of oxygen in the maximum speed tests, and the debts of tests II and III were correspondingly large.

The reliability coefficient for tests II and III was .907$\pm$.026; the corresponding value for test I and the average of the other two was .548$\pm$.103. The high self-correlation of .907 would tend to indicate that one's capacity to exert herself to the utmost for a brief period of

time is a rather stable thing, and that the respiratory and circulatory mechanisms are quite consistent in meeting this sudden demand. It was interesting to note that the length of the recovery time was not proportional to the size of the debts.

An inverse relationship ($-.518 \pm .013$) was found between oxygen debt scores incurred during a standard exercise and those incurred as a result of a short bout of maximal exertion (Wiggins, unpublished report, 1935). This suggests the possibility of using both items in the prediction of physical fitness. Evidently the person in good condition has to borrow less oxygen than a person in poor condition during moderate exercise; but he also is able to incur a larger debt during maximal exertion.

Wyche concludes that oxygen debt determinations are valid measures of endurance on the basis of indirect evidence, and suggests that further attempts be made to secure the positive and unquestionable validation of this test as a measure of endurance.

Before further work was done on oxygen debt determinations, the apparatus was improved by using a Collins spirometer with an oversized dial for noting changes in the volume of the circulating air. Excursions of the pointer on the dial were noted by the operator but not recorded graphically. A new stationary bicycle was equipped with an electric brake instead of the older type of mechanical brake. This was done in order to be able to provide constant resistance regardless of the speed of pedalling.

Yeaton undertook to study the effect of physical training upon the size of the maximum oxygen debt. Her experimental group of five subjects who were obviously poor in endurance agreed to follow a suggested program of exercise and hygienic living. The oxygen debt scores for this group were then compared with those of students who had average and superior endurance. The results were as follows:

Subjects	Mean O_2 Debt	a.d.	Per Cent a.d.
Group I (9)			
Excellent Endurance	3367 cc.	224 cc.	7
Group II (5)			
Poor at Start Test 1	1751 cc.	448 cc.	28
Test 2	1980 cc.		
Test 3	3066 cc.		
Group III (39)			
Unselected Sample	2430 cc.	679 cc.	28
Single Case			
15 Determinations	3849 cc.	257 cc.	7

The group that started with poor endurance and low maximum oxygen debt scores showed rather consistent evidence of improvement (13 per cent between tests I and II; 75 per cent between tests I and

III). Repeated tests on groups I and III would be needed to determine whether training actually was the factor responsible for the increase in oxygen debt scores for group II. The percentage average deviation values indicate the magnitude of individual differences. As might have been expected, group I was much more homogeneous than the other two groups. In view of the fact that the scores for a single subject varied 7 per cent, changes in oxygen debt scores of less than 10 per cent can hardly be considered significant.

Russell continued Yeaton's study of the effect of training. She used ten subjects who were judged to have poor endurance. Five students agreed to follow the suggested program of training; the others served as a control group. Both groups were tested three times, once in January, once in February, and once in March. In all but one case the last oxygen debt score was greater than the first. The amount of improvement was greater in the experimental group.

Snodgrass analyzed Yeaton's data to see if the total oxygen debt score could be predicted from the first half of the data obtained during recovery after exercise. She found that the data could be fitted to a logarithmic curve having the general equation $y=mx^n$. The point at which the recovery rate equals the basal rate may be determined by setting the equation in the derivative form equal to the basal rate and solving for x. Predictions by this method are not reliable enough to warrant their use in actual testing, especially when the exponent is large.

Another attempt to shorten the time needed for the oxygen debt test was made by Dear. Her subjects took the preliminary rest period in the sitting instead of the lying position. The control group of six was given the usual fifteen minute period before each of four tests. The experimental group of seven was given fifteen minute rest periods before the first two tests, ten minute periods before the third test, and five minute periods before the fourth. After the first series of tests, a back rest and adjustable arm rest were provided to make the subject more comfortable as she sat on the stationary bicycle.

The results may be summarized as follows:

Experimental Group (7)	Mean Basal cc/min	Per Cent a.d.	Oxygen Debt cc/min	Per Cent a.d.	Revolutions Per 30 Sec.
Test 1	348	18	3148	51	122
Test 2	271	12	3833	34	126
Test 3	286	9	3866	29	128
Test 4	288	6	3652	18	129
Control Group (6)					
Test 1	298	10	2643	40	115
Test 2	241	7	3126	21	118
Test 3	256	7	3347	27	119
Test 4	263	9	2872	17	121

Particular care was taken to get reliable basal rates in each case. If the five minute preliminary rest period had been too short, consecutive readings for the basal consumption of oxygen would have shown a downward trend. But this was true only in one case. Dear suggested that the average of the last two of four determinations be considered as the basal score, also that a five minute preliminary rest period be used instead of a fifteen minute period.

The measures of individual variation from the group means show a rather consistent decrease from the first to the fourth test. Shortening the length of the rest period was possibly a factor in decreasing individual variations by setting the subject at ease and making the test appear less formidable.

The rather consistent increase in basal rates from tests two to four might possibly be attributed to seasonal variation. Familiarity with the apparatus would be expected to lower the basal rate, to increase the amount of work possible, and to increase the oxygen debt. The amount of work did increase consistently for the two groups, but inspection of individual data shows only two cases of consistent improvement upon each repetition of the test. It is rather surprising to note that increases in the amount of work were not always reflected in increased oxygen debts, even for the group scores. This leads us to the conclusion that the amount of work is not the only factor in acquiring an oxygen debt.

Although some progress has been made in the understanding of the factors responsible for physical fitness and endurance, we are still unable to recommend any cardiovascular or metabolism test for the objective determination of these qualities. Even in the field of fundamental physiological research the outlook is discouraging because of technical difficulties and the large number of conditions that must be controlled in order to get reliable results.

Exercise in Relation to Growth, Diet, and Resistance to Infection: Experiments with White Rats

THE lessons learned from animal experimentation should be carried over into problems of human hygiene and growth only with the greatest caution and reservation. Nevertheless this angle of research provides valuable tentative suggestions for the interpretation of the direct observations which are possible in the study of these human problems. The animal experiments carried on in the laboratories of the department fall into three groups: (1) the effects of fatigue and training upon susceptibility to infection, (2) the effects of certain drugs on the growth of albino rats, and (3) the effect of vitamin deficiency. The list of titles is as follows:

The Effects of Exercise and Fatigue Upon Resistance to Infection, Ida B. Merrill '27.

A Comparison of the Effect of Voluntary and Compulsory Training and Sedentary Living on Resistance to Infection, Florence H. Knauf '28.

The Effects of Certain Drugs on the Growth of Albino Rats, Elizabeth C. Rearick '26.

The Effects of Certain Drugs on the Growth of Albino Rats, Ruth M. Sullivan '27.

A Study of the Effect of Exercise on the Growth and Bone Development of Albino Rats on a Diet Deficient in Vitamin D, Margaret S. Port '30.

The Effect of Vitamin D Deficiency on Susceptibility to Infection, Dorothy Flint '30.

Merrill's thesis has already been reported (*American Physical Education Review,* Feb., 1928). By way of recapitulation:

Experimental animals—white rats.

Infecting organism—B. *pyocyaneus,* in a dosage slightly less than the minimal lethal, injected abdominally.

Conclusions: (1) Fatigue favors susceptibility (measured by mortality after infection) to artificial infection with *B. pyocyaneus* (old terminology), and fatigue after infection is more disastrous than fatigue before infection; and (2) training greatly increases resistance to disease, even when fatigue follows infection.

Spaeth, in 1925, had reported that untrained white rats resisted intraperitoneal infection by Type 1 Pneumococcus better than those that had been trained by enforced exercise. Assuming that this "train-

ing" of rats was comparable to the rational training of the athlete, this record seemed to contradict universal belief based on experience. Thinking that the answer to the seeming discrepancy might lie in the fact that Spaeth's experimental infection was quite foreign to the organism and its normal portal of entry, Merrill had chosen an organism which usually makes its entry through skin abrasion. Knauf (1928) set out to repeat Spaeth's experimental procedure to see if his results could be confirmed.

Knauf used sixty rats: 12 were kept in the usual rectangular cages, 24 in "squirrel" cages, provided with cyclometers to record their daily exercise, and 24 were removed daily from the usual cages and given increasing doses of exercise in a motor driven cage, beginning at the age of 4 weeks and continuing for 15 weeks.

Organism: Neufeld strain of Type 1 Pneumococcus in a stock culture of blood agar. For injection, a 12 hour culture in broth—beef infusion, 2 per cent Witte's peptone, 0.5 per cent NaCl, 0.01 per cent dextrose, pH 7.6; a few drops of sterile horse blood, and a small piece of sterile potato were added after 10 minute autoclaving at 15 pounds. To maintain maximum virulence, animal passage through heart's blood weekly. Minimal lethal dose used.

Criteria of severity of infection: (1) mortality rate, (2) length of time of survival.

Protocols of results may be found in the thesis.

Conclusions: (1) Fatigue induced for two periods of enforced exercise after inoculation decreases resistance to Pneumococcus Type 1. (2) Rats brought into condition by exercising spontaneously for 15 weeks resist infection better than sedentary controls. (3) Enforced exercise every second day over 15 weeks increases susceptibility to infection.

It may be added that in their enforced exercise, Merrill's animals, since they started "training" later in life when they were comparatively heavy, learned to run in the revolving cage fairly well. Knauf's rats, starting younger and lighter, learned to cling to the cage, so that most of their exercise was of the suspension variety.

Rearick's study was on the comparison of the effects on the growth of white rats of tobacco smoke and caffein (1) when they are on an adequate diet, and (2), by way of contrast, when their diet is inadequate. The inadequacy selected was absence of vitamin B.

The dangers of applying the conclusions reached in animal experimentation to problems of human hygiene are exemplified especially forcefully here. Exercise and resistance to infection are after all at least normal phenomena in the experience of rats, whereas smoking and coffee drinking are not.

Control of dosage with the combustion products of tobacco presents

the usual difficulties. In these experiments the animals were kept for a specified length of time in an airtight box through which air was being drawn at a given slow rate from a burning cigarette.

Caffein was administered in the diet in amounts (in proportion to body weight) equivalent to the human consumption of one and two cups of coffee per day .

Experimental animals—47 white rats aged 43 days at the start of experiment—half controls. The numbers of males and females were approximately equal in the various groups. Weights were taken weekly.

Diet—normal and normal minus vitamin B.

Briefly, experiments were carried on in which (a) standardized smoke treatments were given to rats on a normal diet; (b) the same for rats who were alternated every four days between normal and B-free diet; (c) caffein citrate was given every day—normal diet.

The results may be stated in brief:

1. Smoked rats were stunted in growth. After 22 days their weight was 16 per cent less than controls.

2. After treatments stopped, they continued to grow *at same rate* as controls.

3. Smoked rats lost less on the normal diet and gained less on the vitamin B-free diet than did the controls.

4. Rats with .001 gm. caffein citrate per day gained 42 per cent in 24 days. They averaged 8 per cent underweight. Those taking .002 gm. caffein citrate per day gained 46 per cent, and averaged 28 per cent underweight. Controls gained 58 per cent.

Comment: Rearick says, "It was possible to carry on these experiments only between the ages of 43 and 118 days, which correspond approximately to the interval between 3 and 8 years in the human life span—ages which precede the period of human life when the practical problems of the effect of nicotine and caffein are acute and when there is no cause to dispute the proscription of the drugs. However, the marked stunting effect of both drugs, from which in the case of nicotine, it was possible to demonstrate there was no recovery, may tentatively be taken to support the common opinion that caffein and nicotine inhibit growth during the human growth span."

In order to be sure that it is not lack of oxygen rather than presence of combustion products that is responsible for any deleterious effects which may appear after cigarette smoke treatment as used by Rearick, Sullivan (1927) computed the per cent of oxygen which should exist in the treatment box, (1) on the basis of the combining weights of oxygen required to burn the weights of cigarette used during an experiment, and (2) on the basis of the metabolism per gram of rat reported by Donaldson. She also (3) analyzed, with a Haldane apparatus, samples of air from the box at the time of its heaviest load

of smoke. The oxygen volume percentages: (1) 19.3; (2) 18.4; (3) 21.3.

A second preliminary departure from Rearick's thesis is the comparison of the weight graphs of rat and man in terms of time required to double weight—½ week for the rat; ½ year for the man. Bringing the time scales of rat and man into correspondence on this basis, the period during which the rats were smoked (3–15 weeks) corresponds to 1½-7½ years for man! On the other hand, taking sexual maturity as perhaps the more logical point of correspondence in comparing rats and man, 3-15 weeks for the rat (including 9 weeks, the rat time of sexual maturity) would more nearly correspond to 12-18 years for man (including 15 years, the time of human puberty, approximately).

Fifty-two experimental rats were used, equally divided into males and females, and adequately controlled by animals taken from the same litters as the experimental rats. Weights were taken every second day. Diets normal throughout. The various kinds of experiment performed may be seen from the following summary of results:

1. Smoke treatment, 6-15 weeks, no effect on weight gain.

2. Smoke treatment, 3-15 weeks, growth retarded; total gain in weight 75 per cent of that of controls.

3. Progeny of one smoked pregnant female showed somewhat better growth than the average for exp. 2 during the first 6 weeks of the experiment. During the last 5 weeks they grew to about 40 per cent superiority over average of experiment 2. No strict controls available.

4. Rats on 1cc of 0.1 per cent dose of caffein; normal growth. Rats on ten times this dose; growth retarded; weight at end of 100 day, 60 per cent of mean in the first part of exp. 4, and 70 per cent of Donaldson curve.

Port (1930) devised a technique for examination of rachitic conditions in the long bones of the rat. The bones were stripped and cleaned, soaked in a solution of silver nitrate, then in sodium chloride, X-rayed to bring down metallic silver, developed in Burroughs and Welcome Tancol, "fixed" by immersion in hyposulfite of soda, washed, and dried. They were then embedded in plastic wood in a groove in a pine board. When the plastic was hard, the specimens were sawed with a fine toothed buzz saw to divide the bone lengthwise. The section was then photographed and enlarged for study and record. Not all of the factors in this process have been completely worked out, but in adult bones there is in the normal animal a clear distinction between the rich silver deposit in the whole proliferative cartilage zone of calcification, a considerable amount of silver in the whole epiphysis, and a lack of silver in the diaphysis.

Seventy-two rats were used in the first experiment—12 experimentals (D-free diet) and 12 controls in each of the three situations; (1) sedentary living in a stationary cage, (2) living in a "squirrel" cage; (3) enforced exercise beginning with a 15 minute period and increasing daily until the duration reached 2½ hours. Age of rats on delivery, 21 days; age at beginning of experiment, 37 days. Males and females were approximately equated in each of the three divisions of the experiment. Weighings and observations of condition were made periodically.

Preliminary period of sedentary living, 16 days on a diet of 85 per cent "calf-meal" and 15 per cent wheat germ with a little lettuce, cod liver oil, and yeast. At the end of this preliminary period, the rats were put on the Steenbock D-free diet (No. 2965). At the end of the 8 weeks, a male and female control and two male and two female experimental rats were killed and examined by the Hawk and Bergheim "line" test.

The second experiment lasted 12 weeks and followed virtually the same procedure as in the first, except that from the third to the ninth week a control and a rachitic rat were killed each week and their long leg bones examined as described above. At the tenth week two controls and two experimentals were killed and their bones tested. At the twelfth week, the remainder were killed and examined.

Findlay in 1908 and Mellanby in 1921 had observed that exercise retarded the onset of rickets in puppies. On the basis of bone structure examination it was evident from Port's experiments on rats that although there was no marked difference in the severity of the rickets ultimately produced in all three groups, in the exercise group the disease was definitely retarded. Judged by general appearance, weakness in the hind legs, development of pot bellies, and sensitiveness to handling, the enforced exercise group remained better off throughout the experiment than the other two. An argument for required sports?

In Flint's project, 44 albino rats were fed on a D-deficient diet from the ages of 4 to 8 weeks. There were 45 controls. At the end of this period all were inoculated with *B. pyocyaneus*, following Merrill's procedure. In a second experiment, 26 rats were carried on a D-free diet from ages 4 to 8 weeks (30 controls) and then inoculated with Pneumococcus Type 1; preparation of culture and administration as described by Knauf.

In Port's experiment (described above), normal and rachitic rats were being exercised daily in motor driven drums. At the end of this exercise experiment, these rats were injected with *B. pyocyaneus*.

Symptoms of rickets were abundant. Furthermore post mortem examination of tibias and femurs by Port's method bore conclusive evidence of the presence of the disease.

B. pyocyaneus was diluted to what was supposed to be minimal lethal dosage. But the virulence of the culture had apparently diminished since determination of the dose, so twice the dosage was used, and in addition exhaustion afterwards by 2 hours exercise in motor driven cages.

The Pneumococcus strain did not behave in the manner described by Knauf. It had been obtained from a different source from hers and killed in any dilution as it is typically supposed to do. It was therefore injected according to recommendations of Ross (*J.Lab.&Clin. Med.*, 12:567)—1 cc. of 10^{-7} dilution. With Pneumococcus, time of survival was the criterion of resistance to the infection; with *B. pyocyaneus*, per cent survival.

(1) *B. Pyocyaneus*		Per Cent Mortality		
	Rachitic	68		
	Control	67		
(2) Pneumococcus		Time of Death (Hours)		
		Median	Mean	A.D.
	Rachitic	33.8	45.5	21
	Control	37.5	40.5	9

Evidently rachitic condition had virtually no effect on resistance to these infections. However, 85 per cent of the rachitic rats had "colds" during the course of the experiment, as against 68 per cent of the controls.

Neither between body weight or body temperature and time of survival after either infection is there any correlation.

Smoking and Its Effect upon Visual Accommodation

OF THE following eight theses, the first and the last are based on questionnaire surveys of the amount of smoking done by students of Wellesley College, the relation between smoking and health, scholarship, and motor ability, the influence of family and companions, and the prevalence of inhaling. It was deemed important to discover the facts under these headings, since the subject is one of perennial interest and speculation, and has not been thoroughly canvassed in a large college for women. The first thesis in this list deals also with the effect of smoking on vision and associated mental processes. Since, typically, the student's vision is his stock in trade, a concentration on this problem seemed logical. The phase of vision selected was speed of accommodation because it was a function of active neuromuscular control and more or less objectively measurable. From 1931 to 1937, efforts were made with a progressively improved instrument of measurement, to evaluate and analyze the speed of visual accommodation under progressively improved testing conditions.

The apparatus in its present form consists essentially of a means of recording the instant of recognition of a near letter and a far letter in alternation, changing the letter after each recognition, and recording the time cumulatively over a sequence of near-far and far-near transits of accommodation. In general the near letter size was suitable for a 7″ focus; the far, for a 20′ focus. The subjects were either confirmed smokers or those who smoked very occasionally. Absolute non-smokers were not used because of the severe physiologic symptoms sometimes resulting from the smoking experience. The tests were given before and after a thirty minute rest period, also before and after a thirty minute interval during which the subject smoked three cigarettes. Additional tests during the hour following rest and smoking were made only in the 1937 experiments. The list of theses in this group is as follows:

A Study of the Effect of Smoking on the Threshold of Visual Stimulation and the Speed of Visual Accommodation and A Questionnaire Survey of the Extent of the Smoking Habit and Its Effect on Motor and Scholastic Achievement Among Women College Students, Jane Couch '31.

A Further Study on the Effect of Smoking on Visual Accommodation, Louise Schutz '32.

Further Studies on the Effect of Smoking on Visual Accommodation, Constance L. Newbury '33.

A Study of the Effect of Smoking on Visual Accommodation, Reaction Time, and Enunciation Time, Joy B. Rinaldo '34.

A Study of the Effect of Smoking on Controlled Associative Reaction Time, Sara L. Houston '35.

The Effects of Smoking with Particular Reference to Visual Accommodation, Ruth Stevenson '36.

The Immediate and Delayed Effects of Smoking on Visual Accommodation Time, Jean M. Homewood '37.

A Questionnaire Survey of the Extent of the Smoking Habit and Its Effects on Motor and Scholastic Achievement Among Wellesley College Students, Mary M. Yost '37.

Couch (1931) reported Alloway's finding that visual acuity is raised during smoking, drops below normal 10 minutes after smoking, and returns to normal after one hour. With a foot-candle meter (Bunsen principle) adapted to give fine graduations of light intensity through one of the windows, she found that the effect upon the threshold of stimulation to light was irregular after smoking, but that it tended to be in the direction of raising the threshold. She also found, with a relatively crude apparatus, that smoking tends to increase the speed of visual accommodation for near to distant vision.

The questionnaire data summarized and reported by Couch had been obtained by Bielefeldt in the spring of 1930. It will be discussed in connection with Yost's results in 1937.

Schutz (1932) improved Couch's apparatus for measuring accommodation time. The selection of subjects was necessarily based on the ability to read the far letters with reasonable speed and accuracy. Eleven graduate students were chosen by means of trial runs from a larger group of fifteen, and twelve undergraduates from a group of forty. Each group was sub-divided into smokers (habitual) and non-smokers (occasional smokers).

Smoking was found to increase the speed of visual accommodation. The increase was greater for far to near accommodation, a result which may be due to stimulation, through the products of tobacco combustion, of the innervation mechanism of the ciliary muscle of the eye. The effect upon non-smokers was greater than that upon smokers. Rest alone was responsible for about one-third of the increase in speed of accommodation from near to far, and for about one-half of the increase from far to near. Diurnal changes showed a progressive trend toward increase in speed of accommodation time from morning through evening.

Newbury (1933) attempted to isolate the various factors in the neural circuit of the accommodation process. Of these factors, recognition was singled out for special attention. The letter "E" was placed on

the discs in various positions, and the subject stated whether the prongs were directed up, down, right, or left.

Newbury calls attention to the fact that recognition must be considered a factor in accommodation time. Considering her group results, increased speed of far recognition after smoking was virtually identical with the increased speed of the total accommodation-recognition process after smoking. This fact indicates that the increase in recognition speed accounts for all the increased speed of the total accommodation-recognition process. It would seem, then, that smoking has no effect on actual near-far accommodation.

In view of the physiological process involved in near-far accommodation, this conclusion is not unexpected. Changing the focus from a near to a far object is a passive and an elastic readjustment of the choroid coat of the eye, the suspensory ligament, and the crystalline lens. It is not likely that such a process would be influenced by smoke. The only possible effect of smoking would be to speed or retard the reaction time of the inhibition of ciliary tetanus.

If actual near-far accommodation is not influenced by smoke, there is no apparent reason for thinking that it would be influenced by rest. If this is the case, the increased speed after the rest period is due to changes not of accommodation but of recognition.

With regard to recognition of the near letter, which may involve ciliary tetanus, it was found that smoking had a depressor effect—the speed was decreased rather than increased as was the case with the far letter. It seems reasonable to explain the relatively slower speed of near recognition after smoking on the ground that smoking increases the unsteadiness of the highly tetanized ciliary muscle. The speed of far-near accommodation was increased by smoking in spite of delayed recognition.

It was suggested that further experiments be made using monocular as well as binocular vision, also that the factor of enunciation time be investigated.

Rinaldo (1934), with a much improved apparatus, studied enunciation time, reaction time, and the possible ciliary tremor in near vision as factors in the total accommodation time. She found that the speed of simple reaction time was scarcely affected by smoking and that the speed of enunciation time was increased. The change in enunciation time was slight and might be due to changes in recognition time.

Rinaldo's chronoscope for measuring time intervals consisted of two horizontal 12″ aluminum turntables graduated on their edges in degrees and tenths of degrees. These tables were carried on the same vertical shaft and rotated by a phonograph motor at about one revolution per minute. The graduations, then, represented seconds and the 0.1° graduations 0.1 of a second approximately. Time could

be estimated to 0.01 sec. since the 0.1 sec. graduations were about 1.7 mm. apart. Resting on each turntable, concentric with it and fitting the shaft with very little play, was a steel disc 0.01″ thick carrying a light pointer which extended to the edge of the turntable. Above each steel disc three electromagnets were rigidly and concentrically mounted. The lower ends of their armatures were covered with leather pads 1/16″ thick, and the position of the magnets was adjusted so that the pads were barely in contact with the discs. Below each turntable were three electromagnets, mounted in a fashion similar to the upper sets of magnets, but pointed upward into a groove cut on the lower side of the turntable and barely clearing the bottom surface of the groove. Electrical connections were so arranged that the upper set of magnets for one steel disc and the lower set for the other were activated simultaneously.

At the beginning of a run, both pointers were set on zero of the turntable. Enunciation of the near letter would set in motion a series of relays with the final result that the upper disc would be sucked up and its rotation stopped and the lower steel disc would be sucked down and made to adhere still more closely to the lower turntable. Then, enunciation of the far letter would suck down the upper steel disc and draw up the lower disc. The graduations of the upper turntable which passed by under the pointer of the upper disc in the interval between the saying of the near and the far letter would measure the near-far accommodation time. Enunciation of the next letter would suck down the lower steel disc, terminating the time measurement of far-near accommodation time. At the end of the two-minute run, the position of the pointers would indicate the accumulated time for near-far and far-near accommodation. Dividing by the number of letters said (indicated on the automatic counter) would give the average speed of accommodation.

The same operations occurred in measuring the reaction and enunciation time, except that only the upper turntable was used.

A platinum wire on the lower surface of the chronoscope made contact with a mercury cup at each revolution. When this contact was made an electromagnet caused an armature to press down on the stem of an accurately adjusted stop watch. When the time for more than one revolution was desired, a switch was opened until the needle had passed the mercury cup. A correction factor was obtained for each test by dividing the number of seconds required for a revolution of the chronoscope by sixty (the number of degrees marked on the edge).

Further details of the apparatus are given in the thesis which also includes a wire diagram.

Houston (1935) worked with a still more precise instrument of measurement on the problem of controlled associative reaction time.

The average decrease in time after smoking was found to be 7.8 per cent with the effects approximately the same for smokers and non-smokers. Individuals are variously affected by rest. About half of the tests showed an increase in the speed of controlled associative reaction time following the rest period, while the other half show a decreased speed. The rest factor was responsible for less than half of the increase in speed. The increase in speed due to the smoking experience is caused by an increased speed of either association or recognition. Houston stressed the importance of giving the subjects practice tests until they had reached their initial plateau of learning.

Stevenson (1936) reviewed, summarized, and attempted to confirm the work of her predecessors. In her survey and discussion of the literature on smoking, she calls attention to the following points:

It is the carbon monoxide produced as the cigarette burns that is said to be responsible for the headache, nausea, and the feeling of weakness in non-smokers. If tobacco smoke were inhaled for one hour at the rate of five inhalations per minute, about 22 per cent of the hemoglobin in the red blood corpuscles would be saturated with carbon monoxide. However, observations on smokers show that the carbon monoxide is not likely to affect more than 10 per cent of the hemoglobin.

The chief poison in tobacco plant leaves is nicotine. Moist tobacco produces more nicotine than dry tobacco. Also, very rapid smoking is shown to cause a greater intake of nicotine than slow, intermittent puffing. It appears that in a cigarette the paper collects the products of distillation, which are vaporized and absorbed as the cigarette burns to the end. Naturally, the shorter a cigarette is burned the more nicotine there is in the smoke. If a holder is used, some of the hot smoke including nicotine condenses on the cool holder and is inevitably swallowed.

Individuals develop a tolerance for the contents of tobacco smoke. Individuals differ both in the degree of tolerance achieved and in the rate of its development.

The nervous, circulatory, digestive, and respiratory systems of the body are the ones most noticeably affected by the contents of tobacco smoke. Smoking tends to bring the central nervous system back to normal in that it stimulates a fatigued subject and depresses a nervous one. In general, smoking first excites and then powerfully depresses or paralyzes both the central and peripheral nervous systems, in smokers and non-smokers alike. From the anatomical standpoint prolonged poisoning from tobacco causes chronic inflammation and ultimate sclerosis of the nerve elements, exactly as is the case with alcohol. The most noticeable effect on the circulatory system is said to be a 10-20 mm. increase in blood pressure and a 10-20 beat increase in heart rate. The inhibition of hunger due to smoking is generally recognized. The effects on the respiratory system are not clearly determined. It is generally agreed that the mucous membranes are irritated and subject to chronic catarrh.

Many college and university athletic coaches forbid smoking during training. There is a tendency for non-smokers to surpass smokers, but no one can

give the exact physiological reason for this. It is reported that muscular tremor is produced by smoking and that the accuracy of muscular movement is decreased.

A number of writers have reported that in both high school and college the boys who do not smoke are well above the smokers scholastically, although in college the differences are not so striking. To be sure the associations and distractions of the smoking habit rather than smoking itself may be responsible for the lower academic records.

In general, Stevenson's experimental work confirmed previous findings, namely, that smoking speeds up the total process of visual accommodation, that rest alone causes this same result but not to such a great extent, and that occasional smokers are affected more than habitual smokers.

Homewood (1937) verified some of the findings already reported and investigated the delayed effects of smoking. She tested the subjects at intervals for an hour after rest and after smoking. A gradual speeding up of accommodation time was found after the 15-minute rest period. Immediately after smoking, accommodation time was speeded up more than it would have been as a result of rest alone; it remained steady for an appreciable interval and then fell below the decrease in time due to rest. Occasional smokers were stimulated more than habitual smokers immediately after smoking; they are depressed sooner, and to a greater degree.

From the whole series of experiments (1931 to 1937) it can be concluded that smoking first stimulates and then depresses the function of visual accommodation, and that the effects of rest and smoking upon visual acuity, accommodation time, recognition time, and enunciation time can be reliably and objectively measured.

In view of the above experimental work and the statements by various authorities quoted by Stevenson, the questionnaire studies by Couch and Yost seem particularly timely. It was found that the number of students who smoked at Wellesley College increased from 53 per cent in 1930 to 71 per cent in 1937, and the percentage of inhalers from 51 per cent to 82 per cent of the total number of smokers. In 1937, 44 per cent of the students on the scholarship honor lists were daily smokers, 24 per cent occasional smokers, and 33 per cent non-smokers. There were small but significant differences between the honor points earned by smokers and non-smokers—both years in favor of the non-smokers. In 1937 there were differences of 70-150 cc. of vital capacity in favor of the non-smokers, except in the junior class. Except for these same juniors, the smokers had slightly better scores in the motor ability test. The proportion of smokers and non-smokers among students holding offices in campus organizations was just

about the same as for the college as a whole. Certain comparisons between the results of the 1930 and 1937 questionnaires can be made from the following table.

Results for Whole College	Couch (1930)	Per Cent	Yost (1937)	Per Cent
Total Answering Questionnaire	Smokers	53	Daily Smokers	49
	Non-Smokers	47	Occasional Smokers	22
			Non-Smokers	30
On Academic Probation	Smokers	45	Daily Smokers	59
	Non-Smokers	29	Occasional Smokers	19
	No Answer	26	Non-Smokers	22
Medically Restricted	Smokers	56	Daily Smokers	54
	Non-Smokers	44	Occasional Smokers	21
			Non-Smokers	25
Enrolled in Individual Gymnastics Classes	Smokers	51	Daily Smokers	34
	Non-Smokers	49	Occasional Smokers	41
			Non-Smokers	25

Practically all smokers began after they entered high school and before their sophomore year in college. Daily smoking is seldom begun before the junior year in high school, but may be taken up any time during college. The main reasons cited for beginning to smoke are "curiosity," "friends did," "social reasons," and "wanted to." The smokers are about evenly divided on the question of whether or not smoking is a social asset. The great majority of the non-smokers do not think it is.

Yost's findings were reported to the Research Section of the American Physical Education Association in New York City in April, 1937. A resumé of certain aspects of her questionnaire study is to be found in *Science and Society* (London) February-May, 1938.

Neuromuscular Function and Development

BOTH in theory and in practice, physical education has to deal with neuromuscular function and development. Individuals differ greatly with respect to strength, power, speed, and skill in motor performance; some are physically "illiterate" whereas others are well equipped; some are far below their potentialities, others have developed their powers.

The group of research studies to be reported in this section all deal to some extent with fundamental nerve and muscle physiology. Upon this foundation, tests of reaction time, coordination, strength, and power have been evolved. The list of titles is as follows:

The Treppe Phenomenon in Mammalian Skeletal Muscle: An Experimental Study of Its Conditions, and a Discussion of Its Practical Significance in Muscular Exercise, Carol M. Rice '23.

Further Evidence for Decrementless Conduction in Narcotized Region of Nerve, Lucinda H. Rice '28.

A Study in Bimanual Ergography: The Masking of Fatigue Effects Through Variation in Innervation, Mary S. Doupe '28.

Reaction Time with Choice as an Element of Motor Ability, Louise F. Gray '30.

Further Studies in Reaction Time in Relation to Motor Ability, Matilda Shelby '32.

Alertness as a Physiometric Element in Athletic Motor Ability, Dorothy R. Benson '32.

The Reliability of Reaction Time Tests, Dorothy E. Dunning '33.

An Analytical Study of the Elements of Motor Ability with Special Reference to Coordination, Ethel L. Martus '31.

Further Study of the Elements of Motor Ability with Special Reference to Coordination, Mary E. Morse '32.

A Statistical Study of a Modified Form of the Martin Test, Helen R. Sexton '31.

A Study of the Relationship Between the Strength and Power of the Muscle Groups Used in Forearm Flexion and Grip, R. Ruth Baird '33.

The Measurement of Power and Its Relationship to Strength and General Motor Ability, Arvilla E. Nolan '36.

Further Study on the Measurement of Muscular Power and Its Relationship to Strength and General Motor Ability, Maud C. Causey '37.

Carol Rice's experiments in 1923 were devised to produce evidence concerning the occurrence and explanation of the treppe phenomenon in mammalian skeletal muscle. It had been claimed that treppe did not

occur during isometric contractions, also that during isotonic contractions the inertia of recording levers was responsible for much of what appeared to be an increase in contractile power. Furthermore, the accepted explanation of facilitation through small amounts of fatigue products was questioned, and the theory of facilitation through retarded contraction had been proposed (by Fröhlich and Hill).

The experiments were made on rat skeletal muscle *in situ*, forty-two rats being used for this purpose. A few experiments were made on frog nerve-muscle preparations for comparison. A special yoke was used so that any "throw" of the lever could be recorded. Rhythmic electrical stimulation was accomplished by means of a metronome with a mercury cup to make contact with a platinum iridium wire on the bob.

Treppe was shown in a series of isotonic contractions even when inertia influences in the recording apparatus were virtually eliminated. This occurred whether the acceleration of momentum involved was slight or considerable. However as the factor $\frac{1}{2}mv^2$ is increased, the records become less regular and the treppe less easily discernible. The strength of the single shock may be such as to cause contraction only when the electric circuit is broken, or at both make and break. Treppe can be shown in either case. A series of isometric contractions photographically magnified and recorded shows treppe. Series of tetanic isotonic or isometric contractions do not show treppe.

The explanation of the treppe phenomenon on the basis of retarded contraction does not appear to be sound from the standpoint of mechanics. The theory of facilitation through small amounts of waste products was to some extent also discredited because treppe occurred where waste products were present in excessive amounts (ergograph experiments on human subjects).

If treppe is due to an actual increase in the contractility of the muscle, whether from differences in the propagated disturbances or the fiber itself, the warming up exercises an athlete takes before any performance assume added importance. The beneficial effect of preliminary warming up is a matter of everyday experience. There are, however, other factors than an actual increase in extent and speed of possible muscular contraction, notably increased blood supply and better coordination.

Lucinda Rice's work on nerve conduction was done in the physiology laboratories of the Harvard Medical School (1928). Specifically, she set out to determine whether or not the size and branching of the nerve trunk affected permeability to narcotics such as chloral hydrate.

After numerous experiments with nerve-muscle preparations it was concluded that there was no clear correlation between the time required to establish a block and the diameter of the nerve narcotized, although the relatively small branch to the gastrocnemius muscle re-

quired a definitely shorter time for narcosis than the large trunks. Mechanical trauma and diffusion of narcotic through the cut ends of nerve branches were found to be the factors responsible for the experimental results upon which the theory of decremental conduction was based. The true picture of the behavior of the nerve could be obtained only by avoiding injury, particularly at regions of branching, and by ligating the cut ends of nerve branches to prevent diffusion. With these technical requirements in mind, it was possible to duplicate experiments which supported the theory of decrementless conduction in narcotized nerves.

The ergograph study by Doupe in 1928 was an attempt to explain a phenomenon of neuromuscular effort discovered by Stiles who found that when ergograph records are made with the middle fingers of the right and left hand in simultaneous rhythm, a change to alternating rhythm after the fatigue level is well established leads to a marked increase in height of contraction. The subjects operated two ergographs with both hands simultaneously, then alternately, and again simultaneously after the fatigue level had been reached. The total average increase when the hands were used alternately was about 21 per cent for a series of twelve records.

There has been considerable speculation as to whether the locus of fatigue is in the higher cortical centers, in the lower centers of the cord, at the synapses, or at the motor end plates. When the finger flexors were stimulated electrically, simultaneous and alternating contractions were of equal height. From this it was concluded that the increased height in ergograms brought about by alternating movement was a phenomenon dependent on the action of the central nervous system.

By increasing the resistance of the ergograph to prevent the full anatomical range of contraction at the beginning of the series, it was possible to show an increase with alternate contractions before any signs of fatigue were registered. In other words, the phenomenon was not necessarily associated with fatigue.

A final series of experiments was conducted with one hand in the ergograph and the other arm free. Increased contractions on the ergograph were obtained when accompanied by extensions of the opposite arm; decreased contractions resulted when the finger flexion was accompanied by flexions of the opposite arm. Apparently the proprioceptive impulses arising in one contracting group of muscles enhance the contraction in the opposite group of muscles in the corresponding member on the other side of the body. This naturally dominant crossed myotatic reflex must be inhibited when the two hands operate simultaneously.

This work might be continued using an animal like the cat, in

which alternating rhythm predominates, and one, such as the frog, in which movements tend to be symmetrical.

Gray (1930) attempted to evaluate "reaction time with choice" as an element in a laboratory test intended to measure motor ability. Simple reaction time is probably too uniformly developed to afford a means of discrimination among individuals. A much greater range of scores is obtained upon introducing the element of choice because the higher mental functions of discrimination, decision, and judgment are involved.

The reaction time apparatus consisted of a Marietta chronoscope, two visual and two auditory signals with operator's stimulus key and switchboard, and three response keys equidistant from the subject's starting button. After preliminary practice, the subjects were tested for simple reaction time in response to a given signal, for dilemma reaction time when the signals were given in an order unknown to the subject, and finally for dilemma reaction time when the responses to the two visual signals and the two auditory signals were reversed.

Simple and choice reaction time scores were determined for five groups of subjects—four undergraduate sport groups and a group of graduate professional students—as follows:

Group	No.	Simple R.T.	Choice of 4	4 Crossed	Av. Choice R.T.
Tennis	18	30.53	54.39	69.33	61.86
Hockey	32	30.71	54.32	71.44	62.86
Basketball	30	31.16	54.11	72.62	63.36
Volleyball	20	35.05	57.14	72.87	65.01
Graduates	25	31.81	54.58	73.00	63.79

The degree of relationship between choice reaction time scores and other factors is shown by the following coefficients:

	No.	r	P.E.
Fall Sport Grades	125	.379	.051
Winter Activity Grades	97	.212	.065
Academic Grades	125	—.014	.600
Lensch Ball Catch	39	.375	.092
Simple Reaction Time	125	.484	.046

The reliability of the choice reaction time determination is indicated by the self-correlation coefficient of $.871 \pm .032$ which was obtained by repeated tests on the graduate group. Gray therefore concluded that reaction time with choice is significantly related to motor ability and that the test used was reliable.

Whereas Gray worked with small movements of the hand in measuring reaction time, Shelby (1932) used large body movements and also

divided the total reaction time into its two phases—hesitation time, and movement time. Hesitation time, the interval between the stimulus and the beginning of the motor response, is considered to be the true reaction time. Possibly both phases of total reaction time may be independently related to motor ability.

The apparatus consisted of two chronoscopes, four signalling devices, and six response keys—three for the small muscle and three for the big muscle reaction. The tests for simple and choice reaction time (signals uncrossed and crossed) were similar to those given by Gray, but the operator encountered unexpected technical difficulty in administering the tests.

The percentage hesitation record indicated that some people take a long time to decide where they will go, and then move quickly; others may decide quickly and move slowly. Some decide where they are going as they move; therefore, actually, they move more slowly. In all cases, the hesitation time was the predominant factor in total reaction time (an average of 74 per cent for professional graduate students and 66 per cent for college freshmen). The greater the proportion of time spent in hesitation, the better was the motor ability.

The reaction time tests for small muscles were more reliable than those for large muscles. Small and big muscle hesitation time were quite highly correlated, also small and big muscle movement time.

On the basis of several partial correlation problems it was concluded that hesitation and movement were independent factors in both the small and big muscle tests. Since the correlation coefficient of each of these factors with a motor ability criterion was greater than the intercorrelation, the two could be used together (with weightings determined by a regression equation) as the reaction time factor in the analysis of motor ability.

Benson (1932) devised several new tests of alertness to be used in conjunction with the chronoscope records of hesitation and reaction time. The new tests were planned to be short, easy to administer, easy to score, and interesting to the subject. The first of these "Coney Island" tests was supposed to be a measure of instantaneous selection. A series of pairs of golf balls, one black and one white, were dropped in front of the subject who held a horizontally pivoted paddle in her hand. The object was to keep the black ball from falling through a hole in the table. For the second test of selection preceded by suspense, two steel balls were rolled down a wooden trough near the end of which the ball selected by the operator completed an electric circuit and operated a signal. The subject tried to block the ball whose signal was given. The third test was called the "rabbit run." A metal frame was mounted on a flexible steel cable between two pulleys, one of which could be turned with a crank. The subject held a light aluminum rod

in the metal frame and tried to avoid completing the electric circuit by touching the frame with the rod as the operator moved the frame back and forth according to an erratic but predetermined scheme. Every contact between rod and frame was recorded by a signal magnet on a smoked drum. The apparatus for the fourth test consisted of a large kymograph drum covered with paper on which had been traced a standard heavy line of irregular contour. The subject held a pencil in a vertical slot and attempted to follow the line with the least possible deviation as the drum revolved. These last two tests measure alertness in the course of unremitting attention to a moving object. In accordance with Shelby's recommendations, the chronoscope tests were planned for only small muscle response and no crossed signals were given.

All these alertness tests were given to a preliminary group of 60 freshmen, and to 19 graduate students who were tested twice. Each event was T-scored and the T-scores for each subject were added to give a T-score criterion of alertness. When each event was correlated with this criterion the coefficients all ranged between .423 and .541. Inspection of the intercorrelations showed that the events were largely independent—that they did not measure the same aspect of alertness. The reliability coefficients on the small group of graduate students showed that the chronoscope tests were much superior to the "Coney Island" tests.

The next step was to see how alertness was related to other physiometric elements of motor ability. The chronoscope and rabbit run tests were given to a group of 100 freshmen. The scores so obtained correlated .323 with a series of motor ability performance tests (Lensch-Harris criterion). It was concluded therefore that reaction time was a small but important element of motor ability, especially in view of the low intercorrelations with such elements as strength, coordination, and cardiovascular fitness.

Dunning (1933) enlarged upon Benson's chronoscope and instantaneous selection tests, with hope of improving their reliability. Fifty trials were given instead of nine. Following preliminary practice, these tests were given twice (a week apart) to 25 graduate students. Since the instantaneous selection test was so unreliable (.432 for fifty balls) it was discarded and further work done on the chronoscope tests which gave self-correlation coefficients of .861 for hesitation time and .844 for movement time when fifty signals were scored. The corresponding coefficients for the first ten signals were .747 and .486 respectively, and those for the last ten signals were .657 and .749. In other words continued trials tend to decrease the reliability of hesitation time scores and increase those of movement time.

When the subjects were tested a third and fourth time the reliabil-

ity coefficients were somewhat higher than in the first two series. As before continued trials decreased the reliability of hesitation time scores and increased those of movement time. The subject's interest in the test was markedly increased when the interval between signals was shortened. The points to be considered in the further development of reaction time testing are (1) adequate preliminary practice, (2) enough determinations to give a reliability coefficient of at least .8, and (3) provision for making single determinations in rapid succession.

Martus (1931) investigated the subject of coordination as an element in motor ability. In many performance tests of motor ability—notably those of Brace and Cozens—coordination was found to be a major element.

In planning her coordination tests, Martus tried to eliminate, as far as possible, the factors of strength, reaction time, balance, and endurance, to include both small and large muscle coordinations, and to choose events which would be unfamiliar to the subjects. The four events tentatively selected were the egg race, backward jump, hip lift, and the Miles pursuit pendulum test.

For the egg race the subject first ran at full speed to and around a marker (Indian club) twenty yards distant and back across the starting line. Then she repeated this round trip carrying a ball on a wooden paddle. The difference of the times with and without the paddle and ball was used as the score of the event.

The backward jump was given on a hard wood floor. The heels were placed on a white line. Measurement was taken from this line to a place where the toes landed after the jump. One practice and one final jump were allowed.

For the hip lift the subject grasped two handles (18″ apart) on an adjustable, solidly constructed horizontal boom. At one side and two feet from the subject stood a screen of tracing cloth graduated to half inches with horizontal lines. On the other side of the subject and eighteen feet away was a projection lantern. The subject was directed to spring from the floor and elevate her hips as much as possible. The height of the lift was determined by observing the height to which the shadow of her hips moved on the screen. (This technique of determining the height of a jump had been devised ten years previously in connection with the "Sargent Jump" and reported in a paper by Collins and Howe, *Amer. Phys. Ed. Rev.*, December, 1924.)

The pursuit pendulum was a pipe equipped with a nozzle and water reservoir. During each of the five double swings of the pendulum the subject tried to catch as much water as possible in brass cups two inches in diameter. The water caught was measured to the nearest cubic centimeter.

These tests were given twice to twenty graduate professional

students. The reliability coefficients were as follows: hip lift .994, egg race .633, Miles pendulum .503, and backward jump .356.

The same tests were then given to 100 freshmen and the results correlated with the scores on the Lensch motor ability tests. The coefficient for the egg race was .487, for the hip lift .483, for the pendulum test .482, and for the backward jump .371. Coordination indices were then figured from the hip lift and egg race scores. This index correlated .623 with a criterion which included the Lensch motor ability tests and endurance run.

Morse (1932) worked with six coordination tests—the Martus hip lift and egg race, a target test, the scramble, a balance test, and learning a standard coordination exercise.

The purpose of the target test was to measure hand-eye coordination. Twelve regulation darts were thrown with a quick motion of the forearm and wrist. The foot on the side of the throwing arm was advanced to eliminate body movement as much as possible. Each of the twelve successive rings of the target was 1.65 inches wide—this dimension being the standard deviation from the bull's eye when 360 darts were thrown at a 40-inch target.

For the scramble test the subject started on the floor in a supine position. When the signal was given she got up as quickly as she could, ran to a wooden upright 18 feet away, assumed the supine position and clapped her hands on the floor three times; instantly thereafter scrambling again to her feet, running to the starting position and repeating the clapping. The object of clapping the hands on the floor was to insure that a completely supine position had been assumed. Her score was the time it took for three round trips.

The apparatus for the balance test consisted of a hinged wooden frame 6½′ high and 3′ wide which was balanced like a teeter board. Two handles were suspended from the top of the frame. The subject stood with her feet equidistant from the lower fulcrum and grasped the handles at waist height. She was instructed to keep the board as level as possible and was given a one minute trial with her eyes open and then one minute with her eyes closed. The amount of upward motion of each side of the board was recorded in degrees on two motion adders. (See Collins and Howe, *A.P.E.R.*, December, 1924, p. 566).

The purpose of the learning test was to determine the length of time required to learn the exercise "jump between stride standing and standing, one jump in place with double arm bending, stretching sideways, and lowering sideways downward." The parts of the exercise were taught and the exercise demonstrated. The time was recorded from the starting signal until the subject completed the exercise six times successfully and in succession.

Sixty-four freshmen served as subjects. Twenty-five of these were

tested a second time after an interval of five weeks to determine the reliability of the tests.

The selection of the best three tests was made on the basis of validity, reliability, and simplicity of apparatus. The learning test was eliminated because its validity and reliability coefficients were low and because of the comparatively long time taken to administer the test. The balance test was eliminated because it did not correlate very well with the coordination criterion and required complex apparatus. The hip lift was both valid and reliable, but it was eliminated because of its comparatively high correlation with the scramble which was found to be superior with respect to both validity and reliability. The three remaining tests—target, scramble, and egg race—had a multiple correlation coefficient of .836 with the coordination criterion (composite T-score of coordination tests).

The small battery of coordination tests was then given to a group of 100 freshmen. The scores were weighted, according to the regression equation previously worked out, to give a coordination index for each subject.

Laboratory tests for muscular strength have, in general, been made by means of dynamometers. The conventional method, developed by Sargent, Kellogg, and others, involved maximal, voluntary tension against a relatively fixed resistance. The Martin test, on the other hand, measured the point at which the muscles give way when opposed by a superior outside force.

Sexton (1931) chose to work with the Martin strength test rather than the Sargent test because a smaller amount of coordination seemed to be involved, the resistance to each pull being more nearly restricted to a single musculature acting with narrowly prescribed limits. For the most part Martin's technique was followed. The modifications had to do chiefly with the definition of starting positions, the use of straps to localize effort, and the use of levers and pulleys to give the operator mechanical advantage in overcoming the resistance of the stronger musculatures.

The strength of twenty-three musculatures was determined for 100 Wellesley freshmen and for 17 professional graduate students. The tests on the latter group were repeated by the same operator and by two different operators in order to study reliability and objectivity. The sum of the scores in the series of 23 tests was taken as the measure of total strength for each individual.

It was found that the reliability of the single tests varied from about .9 for the forearm flexors, latissimus dorsi, and foot supinators to less than .7 for knee flexors, ankle extensors, thigh adductors and abductors, foot pronators, and finger flexors. The reliability coefficient for total strength was $.860 \pm .043$. The objectivity coefficients ranged from

.884 to .912, indicating that experienced operators can obtain just about the same results.

When the average strength of the right and left sides for each muscle group was correlated with the total strength criterion, the coefficients ranged from .756 for the pectorals to .438 for the finger extensors. Of course the larger muscle groups contributed more to total strength than the smaller muscle groups. Nevertheless the degree of correlation with the criterion needs to be considered in the selection of tests for a small battery.

As far as can be ascertained, Martin made no attempt to develop a short test on the basis of statistical analysis. Sexton worked out three batteries for predicting total strength. In the first she used pectoral and foot supinator strength which gave a multiple of .854 with a reliability coefficient of .892. In the second she took the strength of the abdominals, foot supinators, and forearm flexors which gave a multiple of .875 and a reliability coefficient of .926. When the thigh adductors were added the multiple increased to .903, but the reliability dropped to .873. The Martin short test, consisting of forearm flexors, pectorals, thigh adductors, and thigh abductors, correlated .850 with total strength. In other words Sexton was able to get as good results with two tests as Martin did with four. When Sexton used her four test battery the improvement in terms of predictive indices was 21 per cent.

Although strength is generally accepted as one of the most important factors in physical performance, McCloy has called attention to the fact that it is power, the time rate of work, rather than static strength that determines the degree of success in many athletic events.

Baird (1933) studied grip strength and power, also the strength and power of the forearm flexors using 25 professional students as subjects. Her apparatus combined some features of both the ergograph and the cosine lever. The handle on which the grip of the hand was exerted was connected by an adjustable rod to a very strong U-shaped spring. Minute movements of the spring were transferred through a series of springs and levers to an adjustable writing lever which made a graphic record on the smoked paper of a kymograph. The kymograph could be rotated at a constant speed by an electric motor.

With a stationary drum, the subject was asked to squeeze the handle and so raise the writing lever as high as possible on the drum to give a measure of strength. Then with the drum moving at a known speed the subject was told to grip as strongly as possible in the least possible time. Three strength records and three tension-time records were made of each subject, all being recorded on one drum. After an interval of about two weeks these tests were repeated.

The grip test gave more reliable results than the forearm flexor test. The correlation between strength and power in the grip test was

.608±.085, in the forearm flexor test it was only .417±.130. It also appeared that the speed of pick-up (the time from the origin of the curve to the beginning of the steepest slope) was significantly correlated to the power. When the pick-up time was held constant, the coefficient representing the relationship between grip strength and power was raised from .608 to .695. When strength was held constant, the correlation between pick-up time and power in the grip test was raised from −.578 to −.673.

It was suggested that these experiments be repeated on more subjects, also that the results be compared with those obtained on the McCloy power events and other tests of motor ability.

Nolan (1936) used an A. V. Hill inertia flywheel instead of the Baird dynamometer to obtain measures of muscular power. It was decided to work with one group of freshmen subjects who were very good in motor ability and another who were very poor, so that if there were significant differences and relationships they could be more easily detected.

The flywheel weighing 35.1 kilograms is mounted in ballbearings on cast iron standards. On the shaft of the wheel are two pulleys of different diameters which make possible a pull against different moments of inertia. A 20-inch length of piano wire is wound around the shaft. The wire is looped over a peg on the shaft at one end and over the subject's hand at the other. When the subject has developed maximum tension in an effort to flex the forearm, a release pin is pulled out by the operator. A pen, set in a vertically sliding carriage, is attached by a heavy linen thread to a small pulley which turns with the shaft of the flywheel. When the wheel is revolved, the thread is wound around the pulley causing the carriage and its pen to rise and make a graphic record on the motor driven drum—a kind of "indicator-diagram." A special signal magnet records the point at which the pin is released and that at which the piano wire flies off the peg on the shaft of the wheel. The speed of drum was varied to correspond with the two speeds of the shortening of the muscles as determined by the two pulleys.

The small diameter pull was found to be much more reliable than the large diameter pull, and the results were more consistent throughout with the subjects having high motor ability scores. Power as measured with the small diameter pulley correlated .433±.091 (bi-serial *r*) with motor ability scores and .348±.099 with scores in the baseball velocity throw (See Harris, An Objective Measure of Motor Ability of College Women, p. 19). However, this measure of power did not correlate as well with motor ability scores as the Martin short test or the Martin strength-weight index where the bi-serial coefficients were .640 and .672 respectively.

Causey (1937) followed Nolan's procedure in regard to the selection of subjects and in the administration of the Martin short test, but there was an important difference in the power test. Instead of allowing the subject to develop maximum tension before the flywheel was released, a light spring was used which brought about an automatic release when a very slight amount of tension was developed. Thus it was possible to measure power from virtually the zero point and more nearly parallel the situation existing in the performance of athletic events.

As in the previous experiments, the small diameter pull was found to be much more reliable than the large diameter pull. The correlation between small diameter power and the motor test was .598 as compared to Nolan's .433, an increase of 100 per cent in predictive power. But for the same subjects the correlation between the motor test and the Martin short test was $.776 \pm .073$. Obviously the motor test that was used took other factors than power into account. A power event in this motor test, the baseball velocity throw, correlated .526 with power as measured with small diameter pull. This is much better than Nolan's coefficient of .348, and indicates that Causey's test was more valid. The velocity throw, however, is not an altogether satisfactory criterion of muscular power.

Another power wheel has been recently built to measure the pull of various muscle groups. To test the power of the back and leg muscles the subject stands as for the Sargent dynamometer tests with feet apart, grasping a cross bar adjusted to his height. The quicker and stronger the pull the faster the inertia wheel will turn. The score is the time taken for the wheel to make ten revolutions. Preliminary experiments lead us to believe that this power test will be valid, reliable, easy to administer, and fun to take.

Tests and Analysis of General Motor Ability

THE motor ability test which is now given to entering students in the fall and to freshmen and sophomores in the spring at Wellesley College is the outgrowth of extensive researches by both faculty and students in this department. In the beginning the work was necessarily empirical. Running, jumping, and throwing were obviously fundamental motor skills; their validity was self-evident, and it appeared that they could be reliably and objectively measured. But the development of a standardized motor ability test for college women required more than such generalities. The three thesis studies dealing with the subject in its broader and more practical aspects are:

The Measurement of General Motor Ability for College Women, Dorothea M. Lensch '30.

A Subjective Criterion of Motor Ability and the Proportional Contributions to Motor Ability of Certain Physiometric and Somatometric Factors, Helen Parker '32.

An Objective Measure of Motor Ability of College Women, Jean H. Harris '34.

Lensch's survey of the literature on athletic ability and physical efficiency tests showed that there were no adequate tests for women, and that in the men's field the three most important pioneer studies in the development of standardized motor ability tests were those of Brace, Rogers, and Cozens. It was decided to follow the Cozens procedure, devising tests for each of his seven fundamental elements of athletic ability and working out a small test battery on the basis of validity, reliability, objectivity, ease of administration, and inherent interest to the subject. The test events, classified according to Cozens' scheme, were as follows.

1. Arm and shoulder girdle strength with some abdominal strength: rope climb.
2. Arm and shoulder girdle coordination: swing jump.
3. Hand-eye, foot-eye, arm-eye coordination: baseball catch, baseball throw for distance, "driving the pig to market."
4. Jumping strength, leg strength, and leg flexibility: jump and reach, standing broad jump.
5. Endurance: half-mile walk, bent arm hang, breath holding.
6. Speed of legs with coordination: 80-yard run, 50-yard hurdle, dodge and run.
7. Body coordination: window ladder exercise, cross legged stand.

These tests were given during the first three weeks of the winter

semester 1929-30 to all the freshmen and sophomores of Wellesley College enrolled in the regular class work, except those scheduled for the last afternoon appointment. Three hundred students made complete records.

The raw scores for each event were T-scored, and the average T-scores for each of the seven elements were added, to form the objective motor ability criterion. Instructor's grades for the fall season were used as the subjective motor ability criterion. Each event was then correlated with these criteria and the results compared with those of Cozens:

Cozens (218 subjects) Correlations with: Composite T-Score		Wellesley (300 subjects) Composite T-Score	Subjective Criterion
Hurdles	.740	.513	.227
Dodge and Run	.729	.373	−.051
Baseball Throw	.723	.558	.371
Dash	.681	.612	.200
Standing Broad Jump	.654	.655	.200
Jump and Reach	.546	.543	.304
Rope Climb	.544	.150	.091
Baseball Catch	.460	.648	.236
Swing Jump	...	.570	.305
Driving the Pig	...	.512	.112
Window Ladder	...	.480	.394
Bent Arm Hang	...	.432	.114
Half-mile Walk	...	.323	−.086

Three test batteries were worked out from events which had high coefficients of correlation with the T-score criterion and low intercorrelations. The best of these, consisting of the standing broad jump, 80-yard dash, baseball catch, and jump and reach, had a multiple correlation coefficient of .885 with a probable error of estimate of 22 points on a scale of 400. On the basis of the Lensch batteries, students could be classified with respect to motor ability as follows:

Inferior	500 — 579
Below Average	580 — 659
Average	660 — 739
Above Average	740 — 819
Superior	820 — 900

A large cooperative motor ability project was conducted during the academic year 1931-32 by Harris, Parker, and a group of graduate students who were working on the physiometric elements of motor ability—Benson on reaction time, Circle on cardiovascular tests, Fredrickson on oxygen debt, and Morse on coordination. Data on motor performance, reaction time, cardiovascular efficiency, oxygen debt, coordination, strength, and body build were obtained on the same group of 100 freshmen.

Harris followed Lensch and Cozens in the building of a composite

T-score criterion from a large number of performance test events, and in the selection of test batteries by which students could be classified with respect to general motor ability. The variables in her statistical problem were:

Arm and Shoulder Girdle Strength.—

1. Monkey climb. A vertical 1½″ iron pipe bound with friction tape was securely fastened to the floor and ceiling at a distance of 6″ from the wall. On either side were steps with rubber treads at an angle of 20° with the wall, spaced 19″ apart, the highest 8½′ from the floor, 4 on the left side alternating with 3 on the right. The subject climbed for speed, touching every step on the way down as well as on the way up; time recorded to nearest 1/5 sec.

2. Half pull up. Height of platform on which subject stood was adjusted so that the elbows were bent to a right angle when the horizontal bar was grasped with the reverse grasp. The toes were raised and the knees kept straight. The subject was told to pull up until the chin was above the bar, to lower the body until only the heels touched, and to repeat as many times as possible without stopping.

3. Half push-up. Height of platform on which subject stood was adjusted so that the elbows were bent to a right angle when the parallel bars were grasped opposite the hips. The toes were raised and knees kept straight. The subject was told to push up until the arms were straight, to lower the body letting only the heels touch, and to repeat as many times as possible without stopping.

4. Medicine ball throw. The subject stood toeing a line with both feet, holding a 2½ pound medicine ball overhead with both hands. She was told to throw the ball as far as possible without stepping or jumping. The best of 3 trials was recorded to the nearest foot.

Arm and Shoulder Girdle Coordination with Implements.—

5. Velocity throw. A spring balance dynamometer with a maximum reading index was made fast to the wall with a rope 3′ long. A 210-gram bean bag, attached by a 24′-rope to the spring of the dynamometer, was thrown as hard as possible straight away from the wall. The best of three trials was scored to the nearest pound.

Hand-eye, Arm-eye, Foot-eye Coordination.—

6. Soccer kick. Six balls were thrown alternately to each side by the operator so that they landed and bounced low at specified points 6′ apart. The speed of throwing was set by the metronome. The subject ran from side to side and tried to kick the ball over the goal line within indicated side limits.

7. New ball catch. An electrically driven catapult machine sent twelve 9″ playground baseballs alternately from side to side and at three distances in a predetermined order. The score was the number of balls clearly caught.

8. Accuracy throw. A regulation archery target was hung on the wall so that the bottom was 3½′ from the floor. After one practice trial the subject threw ten baseballs at the target from a line 20′ away. The bull's eye scored 5, the first ring 4, etc.

Leg Strength.—

9. Broad jump. The best of 3 trials was recorded to the nearest inch, the measurement being taken from toe to heel.

10. Jump and reach. A small blackboard, dusted with powdered chalk and marked along the edge with an inch scale, was fastened to a boom so that the bottom was 4′ from the floor. The subject reached as high as possible and made a mark on the board with her middle finger. Then without any preliminary step or jump, she jumped and made another mark as high as possible on the board. The difference between the jump and the reach was scored to the nearest inch.

11. High kick. The height of the shadow of the subject's high kick was noted on a translucent screen graduated with horizontal lines half an inch apart. The score was the ratio of the height of the best of three kicks to the subject's height in inches.

Endurance.—

12. Subjective rating. Physician observed pulse, degree of breathlessness, color, etc, as subject finished Parker's obstacle race (see p. 53-54).

Body Coordination, Agility, and Control.—

13. High obstacle. A barrier was made of a high horse, Swedish box, buck, 5 rolled gymnasium mats, and one long tumbling mat. The subject was timed from the instant she left the floor to the instant she touched the floor on the other side (nearest 1/5 sec.).

14. Ladder climb. Colored flags were tied on the fifth rung of a free swinging rope ladder and on the side ropes between the eighth and ninth rungs. The subject was scored to the nearest 1/5 sec. from the time she started to climb until one foot again touched the floor, having reached the flagged section of the ropes with her hands and the fifth rung with both feet.

15. Balance walk. Three 12′ balance beams were placed end to end. The subject walked the 36′ length as quickly as possible; score to nearest 1/5 sec.

Speed of Legs with Body Coordination.—

16. Eighty-yard dash. Used standing start and recorded to nearest 1/5 sec.

17. Alertness run. A 27-yd. runway was covered with rubber matting; lines marked every 5 yds. across the matting. The subject reversed direction every time the operator gave the signal (signals given at 20, 5, 15, 5, 20, and 10); time was recorded to nearest 1/5 sec.

18. Baby hurdles. Five hurdles 15″ high were set 3 yds. apart, the first 5 yds. from the starting line, the last 3 yds. from an Indian club which marked the turning point for the return trip. The time was recorded to the nearest 1/5 sec.

19. Old ball catch. Hand operated catapult machine sent 10 balls alternately from side to side at every third beat of a metronome set at 126. The number of balls clearly caught was recorded. (The distance from side to side was greater in this test than in the new ball catch; it was therefore more of a test of leg speed and less a test of coordination.)

20. Ponderal Index. The cube root of the weight in kilograms was divided by the height in centimeters and pultiplied by 1000.

Each of these was correlated with the composite T-score criterion and with every other event. Then fifty subjects were re-tested on events that seemed to be eligible for the final test batteries. The push-up and pull-up were eliminated because there was such a high percentage of zero scores, the soccer kick, because too much depended upon the skill of the operator, and the ladder climb, high obstacle, and medical rating because they were not suitable for widespread use in a routine test. The coefficients with the criterion were a little better than those obtained by Lensch. This superior validity was to be expected because some of the poorer events had been discarded. The reliability coefficients were also somewhat better. These results are summarized as follows:

Variable	Validity	Reliability	Variable	Validity	Reliability
Eighty Yard Dash	.724	.855*	Pull-up	.502	...
Old Ball Catch	.677	.150*	Alertness Run	.477	.477
Baby Hurdles	.645	.807	High Kick	.428	.936
Velocity Throw	.633	.882	Balance Walk	.422	.680
Medicine Ball Throw ..	.631	.886	Ladder Climb	.417	...
Broad Jump	.622	.890*	Accuracy Throw	.416	.741
High Obstacle	.603	...	Medical Rating	.339	...
Monkey Climb	.573	.864	Push-up	.297	...
New Ball Catch	.569	.830	Ponderal Index .....—.259		...
Jump and Reach	.561	.759*	Soccer Kick	.224	...

* Coefficients obtained by Lensch on only 14 subjects. The coefficient for the ball catch reflected the circumstances of testing rather than the inherent reliability of this event.

None of the intercorrelations is outstandingly high, signifying that the tests are not measuring the same elements of motor ability. It was interesting to note that the correlations with the ponderal index were all negative, indicating that the stockier individuals had lower test scores.

The five part battery selected for routine use at Wellesley College, consisting of the velocity throw, medicine ball throw, jump and reach, ball catch, and baby hurdles, had a multiple correlation coefficient of .856 which is slightly lower than that obtained by Lensch. However, both these batteries are measuring motor ability as defined by their criteria, and the Harris criterion was admittedly stronger than that of Lensch.

Parker undertook to get a motor ability criterion which should be altogether independent from the Harris performance tests, and to analyze motor ability in terms of available physiometric and somatometric elements. Her motor ability criterion was obtained by getting ratings from eight experienced observers as the subjects ran an obstacle race. The obstacle race consisted of seven events in the following order:

Ladder Climb.—The student was instructed to face the edge of a free-swinging rope ladder, grasp the rope and climb with one leg on either side until her hands reached a flagged section of the rope between the eighth and ninth rungs and her feet touched the flagged fifth rung.

Ball Toss and Catch.—Next, on the run, a light-weight medicine ball 20″ in circumference was picked up from a wire basket, thrown over a high boom, and caught on the other side. If the student failed to get the ball over the first time, she recovered it and tossed it again. If she failed to catch it on the other side she recovered the ball, ran on with it, and placed it in another wire basket.

Rolling the Standard.—An ordinary jumping standard with a round iron base was rolled down a set of double basketball court lines, a distance of about 15′, and back again. The student was told to try to keep the edge of the base of the standard on one line and her feet on the other line.

High Obstacle.—A barrier was constructed with a high horse, a Swedish box, a buck, and five rolled gymnasium mats with one long tumbling mat over the top of all. Over this the student was instructed to scramble in any fashion she wished.

High Jump.—A rope was placed over the brackets of two jumping standards at a height of 2½′ from the floor. This was to be cleared on the run.

Roll-over.—A gymnasium mat was placed lengthwise to the path of the student. She was instructed to roll over lengthwise twice in succession so that hips and shoulders both touched the mat twice.

Low Boom.—A boom was set at a height of 1½′ from the floor. The student was instructed to slide under it as quickly as possible.

The students were told that the test was an obstacle race against time, and that their score would be composed of the total time minus demerits for failure to do certain things such as touching every rung on ladder or not rolling the standard along the line as specified. Careful instructions and demonstrations of actual performance in the entire series of events were given to insure complete understanding. The fact was concealed from the students that they were being graded on their efficiency of performance in each event by a jury seated in the balcony.

The judges were eight members of the staff of the Department of Hygiene and Physical Education of Wellesley College. In order to establish a certain amount of agreement as to levels of accomplishment, moving pictures were taken of four sophomores going through the complete test. These were shown several times to the judges and discussed at length. The graduate students of the department were then put through the tests to enable the judges to practice grading. Four hundred and fifty-six students were tested over a period of seven days.

The ratings of each judge were correlated with those of every other judge for each event in order to determine the degree of concurrence of opinion between the judges and the relative value of the events. The average intercorrelation between judges' ratings ranged from .710

to .765, showing that no judge was markedly superior or inferior to the others. The average intercorrelation for the seven events showed marked superiority for the high obstacle and high jump, and marked inferiority for the roll-over and low boom. The subjective criterion, therefore, was the sum of the ratings by all eight judges on the first five of the seven events of the obstacle race.

This subjective criterion was then correlated with the Harris objective criterion based on her twenty test events. The coefficient was .748, indicating that one criterion has something in it that the other has not. After correlating both criteria with independent measures of coordination, reaction time, respiratory endurance, strength, and ponderal index, it appeared that the subjective criterion is based slightly more on coordination and endurance, and that the objective criterion is based more on reaction time and strength. Of the two the objective criterion is the stronger because its multiple with the physiometric elements is .684 whereas that for the subjective criterion is only .602. On the surface it would seem that the two would dovetail and form a combination which would be superior to either one alone. However with a 1:1 combination the multiple was .670, intermediate between the two coefficients just given for the separate criteria. Further statistical study showed that a 5:1 combination (multiplying the objective criterion by 5, adding the subjective criterion and dividing by 6) gave a multiple of .699 with the physiometric elements.

The purpose of the procedures above discussed for obtaining the best possible "fit" between combined criteria and independent variables should be understood to be for the purpose of throwing light on the composition of the criterion, not as proving or implying its enhanced validity in its final weighting.

Parker collected data on all of the available objectively tested elements for the years 1931 and 1932. She then made a statistical study of their relationships with each other and the various motor ability criteria. It was found that coordination and strength are the two strongest factors in motor ability, but that they affect each other more than any other pair of variables, possibly because, as measured, they overlap. That fact cuts down on their value as a part of a test battery, unless they can be more sharply separated physiometrically. Reaction time is the next most effective factor, but is also affected by coordination and strength. Ponderal index is not as strong a factor in relation to the subjective criterion as it is in relation to the objective criterion, but it is the only factor which has consistently low intercorrelations. The percentage contribution of the five physiometric elements to Parker's subjective criterion and the Harris objective criterion was figured from the special form of the regression equation as follows:

Element	Subjective Criterion Per Cent	Objective Criterion Per Cent
Coordination	36.4	26.1
Strength	27.4	27.7
Reaction Time	20.6	13.4
Ponderal Index	8.9	21.0
Respiratory Endurance	6.8	11.8

Parker suggests (1) further study of cardiovascular fitness and endurance as elements in general motor ability, (2) the addition of laboratory tests of rhythm, (3) study of the relationship between strength and ponderal index, and (4) an analysis of motor skills by means of slow motion pictures to improve our understanding of "form" and coordination.

A motor ability test for high school girls is now being developed along the lines followed by Parker and Harris. The students in charge of this project have secured the necessary data and are now making the computations which will enable them to propose one or more test batteries of known validity and reliability.

Another current project is the analysis of success and failure in each of the five test events of the Harris motor ability test for college women. Freshmen and sophomores (classes of 1941 and 1940) in the first and eighth octile are the subjects. Their performance has been filmed, and a standard interview concerning their experience and preferences in physical education activities has been prepared. The outcomes of this study are likely to prove valuable in adapting teaching procedures to the needs of students who receive low motor ability scores.

Problems Related to Motor Ability

THAT a miscellaneous assortment of subjects will be summarized under this heading can be seen from the following titles:

The Relation Between Various Measures of Mental and Physical Traits, Elizabeth Halsey '22.

The Relation of Motor Ability to That Phase of Mental Ability Concerned in Judgments of Time, Movement, Distance, Position, Velocity, and Weight, and to Motor Attitudes and Associations, Helen B. Schleman '28.

Posture Achievement and Its Relation to Mental and Motor Ability, Harriet S. Reeder '37.

The Relationship Between Physical Capacity and Athletic Ability Among College Women, Virginia M. Kling '29.

A Study of the Subcostal Angle of Four Hundred College Women and Its Alleged Relation to Vital Index, Body Type, and Motor and Mental Ability, Guzin Ihsan '30.

The Relation Between Musical Talent and Dancing Capacity, Yueh-Mei Chen '34.

A Study of the Relationship Between the Sense of Rhythm and Dilemma Reaction Time, Mary B. Nevius '35.

Rhythm: A Survey of the Literature with Special Emphasis on the Relation of Rhythm to Physical Education, Lois Ellfeldt '35.

Halsey's study of the relation between various measures of mental and physical traits should be of more than academic interest to students and leaders in physical education in view of such claims as the following: "Modern psychology has proved that muscles are at one and the same time the source and the vehicles of mental training. Man's intelligence has grown step by step with the use to which he has put his muscles. The human hand developed the mind, and it is now the mind which must build the body" (Hermann, *A.P.E.R.*, June, 1921, p. 285). Obviously if such claims are valid, there should be high correlation between mental and physical ability.

Halsey secured data on two entering classes at Wellesley College (753 individuals) and on 300 professional students in the Department of Hygiene and Physical Education, Wellesley College, from 1910 to 1921. Academic grades and Otis test scores were used as measures of mental ability. The physical measures were height, weight, total strength, and vital capacity. Estimates of athletic skill were made from the combined judgment of captains of teams, heads of sports, and instructors. Estimates of skill in gymnastics were made by specially trained judges during a practical examination. General motor ability was determined by tests of running, jumping, and climbing. In the professional

group, averages of grades received in sports, dancing, gymnastics, etc., represented a combined teachers' estimate of physical ability.

There was practically no correlation between the measures of mental ability on the one hand and physical traits and abilities on the other. The only exception was a coefficient of $.59 \pm .02$ between academic grades and activity grades in the professional group. Physical and mental development correspond to a marked degree during the period of growth, but in adults this relationship can scarcely be considered significant. Halsey has assembled and discussed evidence other than her own in connection with each physical trait and ability.

The lack of significant negative correlations between mental and physical ability is something to be thankful for in view of this choice paragraph of Halsey's "The favorable opinion of the intelligence of able athletes is not, for the most part, shared by the instructor in other subjects. He would read with sympathy Kipling's lines anent the 'muddied oaf in the goal' or 'the flannel'd fool at the wicket,' and would probably state with some degree of assurance that there must be a negative correlation between physical and mental ability. Such a statement was once made to me by a keen educational psychologist who usually displays more scientific caution. When questioned he could advance no evidence, but since I could not, either, he escaped with his views unchanged."

A state of affairs reflected by negative coefficients of correlation between academic grades and skill grades in physical activities could be ameliorated by making the mental content of the latter more evident, thus enlisting the interest of the more intellectual type of student. On the other hand, if the rest of the curriculum could arouse spontaneous interest and give opportunity for initiative and creative effort within the students' abilities, the group which is now absorbed in sports and extra-curricular activity would be drawn to greater effort in its academic work. Moreover, if the public opinion of the college community were more unified as to ultimate values, and did not emphasize different interests as mutually exclusive, there would be a natural and potent motivation toward keen interest and therefore maximum effort in all types of activities.

The conclusions as to the lack of relationship between measures of physical and mental ability among college women are tentative because of the imperfect validity and discriminating power of the available measures. That there is correlation between mental and physical measures in children points to the fact that the different abilities are associated as essential phases of general development.

In the further study of the relation between mental and motor ability, Schleman attempted to restrict the test of intelligence to judgments of time, movement, distance, position, velocity, and weight, to mo-

tor phobias and preferences, and to motor associations. She wished to find out if, in this restricted field, mental ability is correlated positively with motor ability and organic stamina among college women.

The subjects were chosen on the basis of motor ability. The ten freshmen and sophomores of group I were selected by three instructors as the poorest material in their classes for physical education activities. The ten freshmen and sophomores of group II were similarly selected as the best material for physical education activities. Group III consisted of ten graduate professional students.

The tests given were (1) the Schneider test for organic stamina as shown by heart and blood pressure reactions, (2) the Espenschade stairs test (see p. 11), (3) the Martin strength test from which strength weight indices were computed, (4) the pursuit pendulum test measuring alertness and skill of motor control in following a moving object (see p. 43), the balance test, for steadiness and skill in making small adaptations (see p. 44), and a motor judgment test. The latter was prepared on mimeographed sheets. The material on the first page tested the ability to judge time intervals and to describe body movements; the second, distance, position, weight, and velocity; the third, attitudes and interests; and the fourth, associations.

The summary of results is tabulated as follows:

Motor Ability	Schneider	Stairs	Strength Index	Pendulum	Balance	Motor Judgment
I Poor	8.1	19.9 sec.	13.6	92 cc.	940°	65
II. Good	12.3	16.4 sec.	16.5	102 cc.	475°	69
III Professional	14.0	12.2 sec.	16.5	151 cc.	148°	75

The average scores for the different parts of the motor judgment test are in general not so far separated as are those for the physical efficiency tests. When motor judgment was correlated with the latter, the following coefficients were obtained:

	r	P.E.		*r*	P.E.
Stairs	.369	.104	Pendulum	.076	.121
Schneider	.302	.112	Balance	.014	.123
Strength Index	.275	.112			

It would seem either that the everyday ability to judge time, distance, movement, position, velocity, and weight accurately had not much to do with motor ability as a whole or that the motor judgment test was not one that would correctly reflect the individual's real ability. Another explanation is to be found in the inherent unreliability of the various physical efficiency tests.

With the hope of gaining some insight into the character traits of the subjects, the Pressey X-O test for investigating the emotions, and

the Downey will-temperament test were given. It was noted that the Pressey scores had proved to be "more differential" than the Army Alpha test in picking out poor students. Scores for the three groups in these tests were as follows:

Motor Ability	Pressey Emotion Test		Downey Will-Temperament Test		
	Emotionality	Idiosyncracy	Speed	Aggressiveness	Persistence
I Poor	217	52	6.2	4.5	6.9
II Good	233	51	7.1	5.0	6.2
III Professional	194	49	7.6	5.1	6.2

To Halsey's conclusion that there is little or no positive correlation among adults between motor and mental ability as a whole, Schleman adds that the aspect of mental ability provisionally described as "motor-mindedness" (as measured by her motor judgment test) has no relation with skill in timing, spacing, balancing, and gradation of effort in motor activity (as measured in the above described objective tests of physical traits and abilities).

Further evidence along this line was made available by Reeder in 1937. She computed posture achievement grades for the classes of 1935 and 1936 at Wellesley College, using the Pameter developed by Kirch and Howe (see p. 95). It was thought that possibly the amount of improvement in relation to the amount of expected improvement might be significantly correlated with mental ability. But Reeder found that neither initial posture grade nor posture improvement were significantly related to mental ability as measured by the Scholastic Aptitude test and academic grades, or to general motor ability as measured by the Lensch test (class of 1935) or Harris test (class of 1936).

In 1929 Kling attempted to confirm the validity of the Rogers physical capacity test on a group of 103 freshmen and sophomores at Wellesley College. The four athletic ability tests were the 75-yard dash, running broad jump, running high jump, and bar vault. The scores were weighted in several ways to make criterion indices of athletic ability.

From data on height, weight, vital capacity, push-ups, pull-ups, grip, leg, and back strength, the Rogers strength index was computed. For purposes of comparison total strength, a strength weight index, and a strength-weight-vital capacity index were computed from the Martin short test.

The coefficients showing the relation between the indices of athletic ability and the Rogers strength index ranged from .555 to .609 with a probable error of .044. The Martin strength measures gave coefficients from .343 to .540.

The question arises as to why the relation between athletic ability and the Rogers strength index is less marked with girls than with boys when the Rogers technique was duplicated in every possible detail. (The correlation between the athletic criteria and strength index for boys was .77.) Fortunately Kling was able to work with junior high school boys as well as with college girls. She states that the dissimiliarity in natural ability between the two sexes would have been easily apparent to the most casual observer. While the girls required a comparatively detailed and careful explanation, a few words of caution and instruction sufficed for the boys. The fact that the boys so readily understood how to perform the tests may be ascribed to the interest and participation of boys in active play consisting of running, jumping, and throwing, while the activities of a girl are more sedentary in nature. Thus strength, an important factor in a boy's ability to run and jump, would not play such a large part in tests with girls except, perhaps, for those who had had an active childhood, and who, accordingly, know how to use their strength to the best advantage. Thus the Rogers test is not as readily applicable to girls as to boys.

In view of the widespread use of the Rogers test, it might be of interest to quote Kling's discussion summary of this date (1929).

1. Strength and coordination are inseparable in a sense. The question of their relation is one of degree. Strength tests vary from those of pure strength to those requiring coordination *and* sheer strength. In ergography the movement of the second joint of the middle finger involved only two muscles and is almost independent of coordination except the intramuscular type. The Martin test requires more coordination than the ergograph and the Sargent test demands a still greater degree of skill. Pull-ups and push-ups rank still higher in the amount of coordination required. Rogers' test stands at the level where coordination bulks very large over and above pure strength. If pure strength were being measured, strength and weight would be highly correlated. Such is the case with the Martin test where the test is close to the pure strength level.[1] A high correlation was found between the Martin Index and weight at different ages. The only causes for discrepancies would be differences in intrafibrillar and lymphatic chemical condition and in intramuscular coordination.

2. With respect to boys, the Rogers test is not a pure strength test but includes coordination, intelligence, and vital capacity. Endurance is not measured except as extremes of normal growth and nutrition are reflected in the test.

3. Therefore Rogers' test, best described as a semi-athletic test, corresponds to the chemist's requirement of taking a fair sample of a large mass to be analyzed. It is empirical and reveals no physiological

[1] E. G. Martin, *Tests of Muscular Efficiency*, page 468.

basis of athletic ability. Its only usefulness depends on the convenience of application.

4. With regard to time and convenience, the strength test is no improvement over the athletic test. My experience showed the athletic test to be more convenient with respect to handling equipment and in point of time than the strength test. With the substitution of another event, for example, the Sargent jump test, for the high jump, the time of the athletic test could be reduced to two-thirds that required of the full test. A simple battery of athletic events would be more valuable with respect to both time and convenience and as a test of athletic ability.

5. As an empirical test, does it constitute as fair a sampling method as a direct and more inclusive sampling of athletic performances, such as Cozens', for example? The athletic events used by Rogers do not include the range of events usually found in athletic ability tests. Those events which are used overemphasize the strength and coordination of legs.

6. As for the girls, since their athletic coordinations are less and more unevenly developed by childhood habits and training, the pure strength element predominates in such a test and the correlation with athletic ability is therefore lower.

Ihsan (1930) undertook to gather evidence as to the possible relationship between the size of the subcostal angle and such factors as vital index, body type, and motor and mental ability. The problem appeared to be important in view of observations reported by McKinstry (*A.P.E.R.*, Nov., 1922, p. 417) who said that "We have never yet found a small subcostal angle in a woman who has, as a result of her own labor, achieved success of a definite and objective type." Ihsan obtained the following data on 400 students who entered Wellesley College in September, 1929.

1. Subcostal angle. Red dots were stamped along the sides and at the apex of the subcostal angle as the subject stood in normal standing position. In cases of obscurity due to excess of subcutaneous fat or in those subjects who had very acute angles with the sides of the costal cartilages close together, the subject was asked to take in a deep breath, which increased the size of the angle and made the ribs more prominent. During this inspiration, palpation was continued, and on expiration the return of the subcostal angle to the normal was followed and marked. A front view photograph was then taken in the normal standing position. The average of the angles made on enlarged tracings by connecting the point marking the infrasternal notch with successive pairs of marginal marks, was taken as the "subcostal angle." As nearly as could be determined each pair of points represented the anterior ends of a pair of ribs.

2. The area of the subcostal angle was arbitrarily taken as that of the triangular space bounded by the sides of the angle and a horizontal base

distant from the apex one tenth of the trunk length as measured by the distance from the suprasternal notch to the symphysis pubis. The area of this space was measured with a planimeter.

3. The academic index was a weighted average of grades obtained per hour of academic work.

4. Records of vital capacity, height, and weight were obtained from the physical examination cards. From these were computed the vital index (vital capacity in liters times 1000 divided by the height in centimeters) and the ponderal index (the cube root of the weight in kilograms times 1000 divided by the height in centimeters).

5. Motor ability scores were obtained from (1) a motor test made up of a run, a jump, a vault, and a throw; (2) a test of posture and carriage; (3) a free standing gymnastic test of four exercises; and (4) an apparatus test of straddle vault on the buck and hand traveling on the horizontal ladder.

6. Extracurricular activities were recorded in the cases of those students participating in dramatics, holding office during the year 1929-30, or elected to office for the year 1930-31.

The correlation between the subcostal angle and subcostal area was .780± .013. Coefficients of insignificant size were obtained when the subcostal angle was correlated with academic index, vital index, ponderal index, and motor ability, as can be seen from the following table:

Correlations With Subcostal Angle			
	r		r
Subcostal Area	.780	Ponderal Index	.280
Academic Index	.089	Motor Ability	−.092
Vital Index	.009		

The average subcostal angle for those participating in extracurricular activities was 57.28°, for those not participating, 58.18°. The frequencies and percentage of office holders for each subcostal angle class were as follows:

Subcostal Angle	Total Frequency	Office Holder Frequency	Per Cent Office Holders
26—35.9°	11	3	27
36—45.9°	48	6	12
46—55.9°	104	16	15
56—65.9°	86	15	17
66—75.9°	60	7	12
76—85.9°	26	5	19
86—95.9°	7	1	14

The explanation of the origin and perpetuation of the idea that the subcostal angle has a predictive value for objective accomplishment appears to be associated with the non-statistical observation of in-

dividual cases in which an unimportant or at least unexplained concurrence of events is mistaken for cause and effect. It is easy to see how an adolescent coming under the influence of a teacher of physical education of powerful, stimulating, and aggressive personality would discover her latent capacities, and partly due to this awakened sense of her own inherent power, partly through the drawing out of force of imitation, rise quickly to noteworthy accomplishment. Reinforcing, strengthening, and in a sense, part of this rapid evolution of personality, would occur an improvement in posture, endurance, strength, general health, and incidentally, an increase in subcostal angle resulting from that portion of her physical training activity which has to do with the cultivation of lateral costal breathing and an erect position of the chest.

But on the basis of reasonably satisfactory data on a large unselected group of college students it is evident that the subcostal angle has no predictive value for motor, intellectual, or social achievement, no correlation with the vital index, and very little with body type as measured by the ponderal index.

Chen (1934) made a statistical study of the relation between musical talent and dancing capacity. No attempt was made to analyze and measure fully all the factors of musical ability, only those represented in the well-known Seashore tests for pitch, intensity, time, consonance, tonal memory, and rhythm. It was proposed to rate a representative group of students who were taking work in dancing, on their dancing capacity and sense of rhythm, and to give them the musical tests. The dancing experience of the 93 students who took part was varied; some were in the beginning class, some in the intermediate class, some in the advanced class, and some in Orchesis, the honor group. In other words, the group covered a wide range and was unselected.

The results in terms of zero order correlation coefficients were as follows:

Variables	Dancing Capacity	Dancing Rhythm	Seashore Total
Dancing Rhythm	.822	...	...
Seashore Total	.511	.561	...
Pitch	.393	.404	.682
Intensity	.045	.010	.359
Time	.276	.343	.644
Consonance	.359	.313	.553
Tonal Memory	.394	.478	.687
Musical Rhythm	.418	.387	.589

Omitting the factor of intensity, the coefficient of multiple correlation between dancing capacity and the five remaining Seashore tests was

.558, P.E. (est.) ±11 on a rating scale of 100. From the special form of the regression equation the percentage contribution of each element to dancing capacity was found to be:

Factor	Per Cent	Factor	Per Cent
Rhythm	28.9	Tonal Memory	15.2
Pitch	24.8	Time	8.7
Consonance	22.4		

The conclusions are that music and dancing have such important elements in common that it is justifiable to give tests in music for diagnosing the nature of personal difficulties and discovery of aptitudes of college women in dancing.

It is generally admitted that the qualities of rhythmic perception, or rhythmic movement, or both, are important factors in all types of motor performance. But as yet it has not been possible to evaluate them objectively in the teaching problems in physical education or to include the measurement of these qualities in tests of motor ability. Strength, alertness, coordination, and endurance are comparatively easily defined and are understandable in objective terms. But "rhythm," simple enough in its more obvious outward manifestations, remains intangible and obscure as to its essential character and its physiological basis.

Nevius took as her problem the study of the possible relationship between rhythmic perception and dilemma reaction time to tone signals. She had reason to suppose that ability to follow a musical pattern with an appropriate movement pattern might be correlated with quickness of distinguishing between tones of different pitch.

Her thirty subjects were selected at random from the classes in modern dance and from the graduate students of this department. To them were given the Seashore tests of rhythm, time, and pitch, and a test of time reaction to tone signals. The signals were any one of three percussive musical tones—C, E, or G.

Instead of the Marietta chronoscopes for measuring reaction time, the Howe chronoscope described by Rinaldo was used (see pp. 32-33). The signals were given in quick succession and cumulative reaction time scores obtained.

The variable of pitch discrimination concealed in the reaction time test turned out to be so strong, in spite of the wide spacing of the tones, that the test became virtually one of pitch discrimination. As such it showed no relation to rhythm perception. Low intercorrelations among the Seashore tests of rhythm, time, and pitch were confirmed, but no headway was made in the analysis of rhythm sense, either perceptive or motor.

Ellfeldt has presented a critical survey of about 200 references in the field of rhythm under the following main headings:

I. Historical—psychology, music, dance, physical education.

II. Theories concerning the nature, development, and perception of rhythm.

III. Objective studies of rhythm and its measurement. Auditory, visual, and motor rhythm.

VI. Problems of rhythm in physical education.

a. The confusion with rhythm of the terms tempo, cadence (as in marching), timing, and coordination.

b. The relation between auditory and visual perception of rhythm and its motor expression.

c. The rhythmic pattern arrangement for teaching various coordinations in sports.

d. The rhythmic performances of rowing, swimming, horseback riding, and gymnastic exercises where rhythm, timing, and coordination are fused.

e. The subtler and more complicated rhythms of dance.

Problems Related to Administrative and Teaching Procedures in Hygiene and Physical Education

THE thesis studies submitted under this classification are the following:

The Physiologic and Anatomic Basis for the Selection and Limitation of Women's Motor Activities, Emma F. Waterman '25.

Accidents in Physical Education Activities for College Women, Mary G. Fessenden '33.

Epidermomycosis Interdigitale: A Review of the Literature, Virginia Cleary '33.

A Standardized Test for Measuring the Health Knowledge of Children in the Elementary Schools, Adelle M. McLoon '26.

The Testing of Health Knowledge in the Third Grade, Carolyn J. Nice '34.

A Preliminary Analysis of the Game of Tennis, the Reliability of Certain Tennis Skill Tests, and the Determination of Practice Board Areas for Serve and Drive, Virginia Mynard '33.

A Practice Board Test of the Fundamental Strokes in Tennis, Jeanette Cutts '35.

An Analysis of High School Girls' Basketball in Terms of Frequency of Occurrence of Technical Elements of the Game, Josephine E. Renshaw '33.

Waterman (1925) discusses at some length the physical and physiological differences between man and woman. These may be summarized briefly as follows:

1. Male infants are a fraction of a centimeter taller than female infants, but in most other respects there is a close correspondence of proportionate measurement in the two sexes.

2. The ossification of bones occurs sooner in girls than in boys, and the body proportions change somewhat during childhood.

3. Girls are distinguished by broad hips and legs which are both actually and relatively shorter; also the relative gain in length of arms is less in girls. This accounts for the fact that the center of gravity is higher in men. Note was made of the fact that in the course of racial evolution, the increased size of the pelvic outlet was needed to permit the birth of large-headed infants, and that the female pelvis has of necessity become less stable than the male pelvis.

4. Growth in height is completed much sooner among girls than boys. After the age of fifteen the boys definitely excel in height, but girls are heavier per unit of height.

5. Of the organs, the heart and brain deviate most widely from the rule that the size of most organs increases fairly regularly. The absolute weight of the brain is greater in man than in woman, but there seems to be a marked precocity of the female brain in childhood. Growth in brain size continues to about the age if twenty in women, whereas man's brain does not reach its maximum size until about thirty.

6. The blood of men contains less water and more red corpuscles, and is, consequently, of higher specific gravity than the blood of women until after the age of child-bearing. The fact that the specific gravity rises in old women may be a factor in the greater longevity of women. A good physique is associated with a high specific gravity of the blood.

7. The basal metabolism of women is distinctly lower and more variable than that of men.

8. The male pulse rate is lower than the female, even before birth. The average for a group of 90 women was found to be 69 and for 121 men 61. Nevertheless college women obtain scores for cardiovascular efficiency (Schneider test) which compare favorably with those of men.

9. From puberty the male increases far more in lung capacity than does the female although up to the age of ten they are fairly even.

10. Boys surpass girls at all ages in strength and endurance. The difference becomes more marked after the age of fourteen. The strength of men, even allowing for the differences in weight, is much greater than that of women. The chest, back, and forearm muscles are relatively weak in women. One of the most striking features of the strength of adult women appears to be its correlation with mental alertness rather than with the size of the muscles.

11. The mortality rate is higher for males than for females. It is during the very earliest period of life and at the latest that the greater mortality of males is most clearly marked.

The special problems of puberty and menstruation are discussed in some detail. Of particular importance are the acceleration and inequalities of growth and the appearance of secondary sex characteristics. The systolic blood pressure rises rapidly until the onset of puberty. The need for rest and relaxation is great at this time, also the need for plenty of moderate outdoor exercise. The nervous element brought into interschool contests makes them inappropriate for this age period, particularly if the competitive features are overstressed.

Menstruation seems in many cases to induce a state of increased nervous instability and excitability. Blood pressure, pulse rate, respiratory rate, and muscular strength are slightly decreased during the menstrual period, but not to such an extent that it should interfere with normal activities. In general, normal menstruation is not accompanied by pain, although there may be a sense of heaviness and discomfort in the pelvis. However, various surveys show that the majority of girls and women suffer from disturbing symptoms such as pain, headache, lassitude, depression, and profuse sweating.

In discussing the hygiene of menstruation, Waterman steers a mid-

dle course between those who advocate excessive caution and those who recklessly disregard all precautionary measures. There is apparently some danger in too heavy work, but lack of adequate muscular activity is by far the more common cause of difficulty. According to McKinstry weak muscles of the abdomen, back, and sides; incorrect breathing; too little rest, sleep, and relaxation; constipation; and improper clothing are common causes of menstrual discomfort. It has been shown that intelligently directed exercise is a factor of considerable importance in the relief of various menstrual disturbances. However, no single routine can be applied to all individuals. It is generally considered wise to refrain from very strenuous exercise during at least the first few days of the menstrual period, but every effort should be made to interrupt the regular routine of life as little as possible.

When primitive and civilized women are compared it is apparent that the former are characterized by a sturdy physique, a great capacity for work, and premature aging, whereas the latter have more intellectual power and charm and a lower average of physical efficiency. Femininity and weakness are not inevitably connected. The suggestion is made that by establishing better habits of exercise, civilized woman may achieve a degree of ruggedness that would be eminently desirable.

That defects of various sorts and general weakness are by no means limited to the female sex was demonstrated at the time of the World War, when at least a third of the men drafted in this country were rejected for physical reasons. We should recognize the fact that the advances in intelligence and in the civilization of our race have been won at the expense of a weakened physique, not only for women but for men. The problem now is to continue toward further civilization and at the same time to foster rather than handicap physical development, so that the leading races of the modern world may have strong, stalwart men, and active, energetic women.

In 1933 Fessenden made a questionnaire study of accidents in physical education activities for college women. The ratios of number of accidents to people enrolled in an activity, based on data from fifty colleges and universities, were tabulated for a total of 278 accidents.

It was found that the accident ratio in basketball was about twice as great as that for fistball, tumbling, or hockey. The smallest ratios were for dancing, swimming, and tennis. In the following table it is interesting to note that dancing, swimming, and gymnastics have the largest enrollments, and that tennis, basketball, and volleyball come next.

Activity	No. of Accidents	Enrollment	Per Cent Injured
Basketball	101	5311	1.7
Fistball	2	217	.92
Tumbling	10	1024	.88
Hockey	41	4470	.85
Riding	7	1061	.66
Soccer	9	1531	.59
Gymnastics	24	6465	.34
Track	2	609	.33
Volleyball	16	4733	.32
Baseball	5	2143	.23
Dancing	19	10627	.15
Swimming	13	8013	.14
Tennis	3	6083	.03
All others	26		

In general, injuries occurred to the ankle more often than to any other part of the body, but injuries to the arm, shoulder, and foot have the most serious consequences. Sprains occur more frequently than other types of injuries. Fifty per cent of basketball injuries are sprains. On the average 17.4 days are lost from physical education activities for all those accidents for which the number of days lost is stated.

The classification of accidents according to cause is as follows:

Cause	No. of Accidents	Per Cent of Total
Carelessness	63	23
Previous Weakness	37	14
Collision	29	10
Lack of Coordination	18	7
Inexperience	17	7
Equipment	11	4
Fatigue	8	3
Failure to Follow Directions	6	2
Lack of Strength	6	2
Fear	1	.5
Overconfidence	1	.5
Miscellaneous	8	3
Not Stated	73	30

Cleary's bibliography on epidermomycosis interdigitale, commonly known as "athlete's foot" embraces nearly two hundred references which are well organized and analyzed. For effective action in the solution of the public and personal health problem of "athlete's foot" a continuation of experimental studies in pharmacology and hygiene in relation to the parasite is unquestionably needed; but more than this, perhaps, at the present time, there needs to be a gathering together of what is already known and a discarding of what is baseless hearsay and commercialism.

A glance at the table of contents of this 115-page thesis indicates its scope: Terminology, History, Pathogenic Organism, Clinical Aspects, Diagnosis, Microscopic Examination, Methods of Growing Cultures, Culture Appearance, Manner of and Conditions Favoring Invasion,

Source of Infection, Frequency, Prevention, Treatment, Viability, Immunity, Comments and Suggestions, Conclusions, Glossary.

There seems to be a general acceptance of the following points:

1. The infecting agent is, in the majority of cases, the epidermophyton or the trichophyton, both of which are molds.

2. The best method of diagnosis is the microscopic examination followed by a cultured growth of the fungus on Sabouraud's medium.

3. The skin between the toes acts as an excellent culture medium for growth. Warmth, moisture, and injury are predisposing factors in infection.

4. Since the infection is thought to be spread by skin scales deposited upon the wooden floors of shower rooms, dressing rooms, and the runways of swimming pools, much care must be taken in cleansing such floors. The organism does not grow on dry wooden floors as moisture is necessary for the growth of the fungus. Bonar and Dreyer advise the use of zinc chloride on the floors of dressing rooms for disinfecting purposes. This substance shows a high degree of killing power in concentration of 5 per cent or more. The time necessary for killing is a day or longer. Sodium hypochlorite solution must remain in contact with the material for at least a couple of hours in order to be effective. Copper sulphate is ineffective and there are many worthless proprietary floor washes on the market today. Boiling water is perhaps as effective as any of the above named floor washes.

5. The feet should always be covered in shower rooms, especially if the floors are not disinfected or thoroughly cleansed every day. Paper or rubber bath sandals with no fabric lining, are advised. Foot baths of 1 per cent sodium hypochlorite solution have been very successful in checking the spread of the infection. Foot baths are meant to prevent, not cure the disease.

6. The infection may be prevented by the cultivation and continuance of good hygienic habits. The feet should be washed thoroughly each day with soap and water and the stockings changed frequently. If the feet perspire freely, the use of a chlorinated disinfecting powder is strongly advised. The feet may be soaked in salt water to good advantage. It is advisable to wear light weight shoes, especially in the hot weather, so as to keep the feet cool and well aerated.

7. Although various methods of treatment have been suggested and tried, there is no one method which meets with success in every case. Any successful agent for treatment must be kerolytic in its action and have sufficent antiseptic power to kill the fungus. Whitfield's ointment and iodine, if not used in excess, are rather successful in checking the disease.

8. So far there is no way of producing immunity.

McLoon (1926) developed a standardized test to measure health knowledge. Her tests represented three levels of difficulty. That for the first level (third and fourth grades in the elementary school) contained fifty exercises of approximately the same degree of difficulty; those for the second and third levels (fifth-sixth and seventh-eighth respectively) contained a hundred exercises each. The completion method was chosen as the best form in which to present the test

items because it eliminates the possibility of increasing the score by guessing, it avoids calling attention to negative ideas about health, it affords an opportunity to emphasize the positive side of health work, and it compels the pupils to express themselves in a constructive manner. One "yes-no" question was included in each section for variety.

The completion test had to be somewhat modified for use in the third grade. The children read more easily than they spell at this age; they readily comprehend the sentences, but have difficulty in spelling the word to fill the blank. As the purpose of the test is to measure their health knowledge, and not their spelling ability, words for every two groups of exercises were placed in the center of the page. In order not to make the test too easy, superfluous words were included in this list as is shown in the following sample page:

NUTRITION

I. *Eating Habits*

a. It takes at least.....minutes to eat a meal properly.

b. Do not drink while the.....is full of.....

c. Should you eat candy between meals?

food	go	mouth	grow	ball
nine	chew	in	four	be
at	thirty	have	makes	stop

II. *Milk*

a. Milk.....us.....tall and strong.

b. Children should drink at least.....cups of milk a day.

c. Should milk be kept in a warm place?

This kind of a test may seem to have some of the bad features of the recognition type. It does, somewhat, but at least a deliberate misstatement is not made.

The three McLoon tests were given to large groups of children in three communities—an industrial town, a residence town, and a residence city. The pupils in the schools of the first town had had practically no special health training. In the second, the pupils had had health instruction from the school physicians and nurses. In the city the health program had been organized on an efficient basis for the preceding seven years. The tests discriminated very clearly between groups that were known to differ in health practice and knowledge. The score for the first town was 33.9 per cent, for the second 43.7 per cent and for the city 52.3 per cent. In the case of the city, the health supervisor's estimate of the efficiency of the health program of the individual schools coincided with the ratings given by the test.

Further work on a health knowledge test for the third grade was done by Nice in 1934. Since the chief difficulty seemed to be due to the wide range of ability in reading and writing, she used oral directions and pictures as much as possible.

The first form of the test was evidently too easy for third grade children, since more than 50 per cent of the children answered all but two of the items correctly, and the standard deviations were comparatively small. The reliability coefficient was .66 and the correlation with the teacher's estimate (for 139 pupils) was .46, a value just about the same as that obtained with the McLoon test. The correlation between the picture test and the McLoon test on 71 pupils was .36.

In view of the apparent self evidence of picture meanings to adult eyes and of the oral tests on small groups, and in view of the high place that visual imagery is supposed to occupy in child thinking, the general levels of validity and reliability of the picture tests were much lower than were anticipated. Evidently there are unsuspected obstacles in the way of making clear the meaning of the unlabeled picture, even as there were recognized obstacles in the way of making clear the meaning of the printed statement which is unaccompanied by pictorial illustration. Nice says that the construction of valid and reliable forms of the picture test should be possible in the light of her findings.

Mynard (1933) made a preliminary analysis of the game of tennis by means of check lists. Both singles and doubles were used in order to obtain comparative frequencies from the two situations, each of which was checked for eight ten-minute periods. The subjects were intermediate and advanced players. Six hundred and thirteen strokes were checked during the 80 minutes of play and the percentage frequencies computed as follows for the various strokes:

Stroke Played	Singles Game		Doubles Game	
	Frequency	Percentage	Frequency	Percentage
Serve	243	39.6	299	50.3
Forehand Drive	219	35.7	199	33.5
Backhand Drive	125	20.5	38	6.4
Volley	9	1.5	24	4.0
Lob	11	1.8	21	3.5
Smash	6	0.9	14	2.4

Six tennis tests were then given to groups of elementary, intermediate, and advanced players. Procedure:

1. *Serve*—5 balls from the right service court and 5 from the left.

2. *Drop-bounce forehand*—10 trials, the subject standing on or behind the center of the baseline.

3. *Drop-bounce backhand*—10 trials as for forehand.

4. *Machine forehand drive*—15 trials after 5 practice trials; balls sent from across the net by a motor driven machine.

5. *Machine backhand drive*—15 trials as for forehand.

6. *Smash*—10 trials after 2 practice trials; balls sent from motor driven machine.

The reliability coefficients were found to be as follows:

Test	Number of Subjects	r	P.E.
Bounce-drive forehand	25	.842	.039
Serve	25	.756	.058
Bounce-drive backhand	25	.713	.066
Smash	25	.533	.096
Machine backhand	16	.507	.106
Machine forehand	18	.445	.124

Although the drop-bounce drive tests were more reliable, they are likely to be less valuable in a testing program. The machine tests more nearly approximated the actual game situation. The serve, the machine forehand drive, the machine backhand drive, and the smash are recommended by Mynard for further study. If they can be shown to be valid, they could be used to good advantage for purposes of classification and achievement.

Mynard also made determinations of practice board areas for the serve and drive. Sixty individuals of varying standing heights and playing ability were chosen to serve as subjects in the experiments on serving. For the determination of the forehead drive area a smaller group of 25 subjects was used, but in this group too, the abilities ranged from beginners to advanced players, with standing heights showing a normal distribution.

Horizontal and vertical strings were placed above the net. The operator stood beyond the service court into which the subject was serving and observed the height of the balls as they came over the net and bounced as good serves. The horizontal string was raised or lowered to approximately the mean height of the balls as they had crossed the net. A check on this adjustment was made by having the subject serve ten more balls into each of the service courts. The balls were scored on the basis of how many went through the string area and landed as good serves. The height of the string above the net for different individuals varied from 1′11″ to 2′9″ with an average height of 2′3½″. The width of the area was set at 9′. When this average area was tested out on 16 players, 76 per cent of the total number of serves went through the area and landed as good serves; 1 per cent of all balls going through the area were faults. One may conclude from these figures that 99 out of 100 balls hitting an area of these dimensions on a practice board would be good serves if a whole court were being used. The reliability of the service test, using the determined area, was found to be .769±.069.

The average drive area was similarly found to be 12′ wide and 2′2½″ high. When this area was tested out on 10 players, 59 per cent of all balls going through the area landed in the back of the court. An additional 6 per cent struck the opposite court closer to the net than the

serving line, making a total of 65 per cent of the drives good. The reliability coefficient for the forehand drive test, using the determined area, was found to be $.837 \pm .064$.

Of course the number of subjects used to check up on the validity of the suggested areas was small, but this study gives reasonable assurance that the use of a practice board can be a valuable adjunct for both testing and practicing the tennis serve and drives.

Cutts (1935) attempted to establish a standardized classification and achievement test for women tennis learners of college age. The technique was the usual one of:

1. Determining a reliable, objective criterion of tennis playing ability.
2. Choosing those specific skills that are fundamentally most important in successful playing.
3. Devising the test forms for those skills.
4. Choosing test forms on the basis of reliability, practicability, high correlations with the criterion, low intercorrelations.
5. Performing the usual statistical work leading to a regression equation, multiple correlation, and probable error of estimate.

The criterion of tennis playing ability was the number of points won out of 36 points played against a steady "standard" player. The service alternated every three points.

The tests selected for the test battery were service, forehand rally, backhand rally, forehand-backhand rally. All tests were arranged for the practice board. Service was measured in terms of accuracy of aim at the service board target recommended by Mynard. The scores in the other three tests depended both on accuracy of placement on the practice board and on speed of handling the ball. The rally tests were modifications of the Dyer test.

The multiple correlation coefficient between these four tests and the tennis playing ability criterion was .743 with a probable error of estimate of 1.62 on a scale of 16 points. The battery reliability was .677. Doubling the length of the tests would raise this figure to .796. The special form of the regression equation shows that the forehand-backhand rally test makes the largest contribution to tennis playing ability, while rallying with the backhand alone makes the least contribution.

The reliability of this battery of tests is too low for individual measurement. The multiple correlation is too low for other than rough classification as beginners, intermediates, or advanced players. Since the first and third groups can be placed by definition and cursory observation, and since the time required to test a large squad would use up an undue proportion of the playing season, the classification value of this or similar tests is open to question.

Renshaw's analysis of high school girls' basketball with respect to the frequency of occurrence of technical elements of the game was undertaken in order to provide a scientific basis for the selection of tests to measure achievement in the technical elements of the game, and for the selection of the most important elements to be presented to a class learning to play basketball.

A number of tests for measuring basketball efficiency have been advanced, most of which consist of various types of passing and shooting, and a few of bounces, juggles, and pivots. In most of them, one or two possible elements of basketball have been selected for testing, and many other points which make for good basketball presumably disregarded. In no case does there seem to have been an effort made to determine the most common characteristics of the game by checking the technical elements as they occur during playing time.

One means of validating basketball tests or test items would be to base them on an analysis of the game itself. Empirical and philosophical approaches, as well as surmises and opinions are necessary, of course, in the analysis of such a complex game. But it can readily be seen that tests built on the findings of a survey of the frequency with which each of the expected elements actually occurs in the game situation would tend not only to verify the analyses made by experts, but also to measure what is taught and played rather than what ought to be.

After a thorough search had been made through all available material on how to teach, coach, or play basketball, a number of check sheets were constructed comprising detailed lists of the elements thought by experts to be characteristic of basketball. An attempt was made by the author and several second year professional students to record the play of freshman and sophomore basketball classes at Wellesley College during the fall season of 1932. It was found, however, that the game progressed too rapidly to permit one checker, working alone, to record more than a small percentage of the elements. The check lists were revised and simplified to a great extent, but a second attempt at using them met with no greater success than the first.

It was then suggested that it might be possible to record the progress of a game, play by play, on a dictaphone. After the operator had familiarized herself with the elements thought by experts to be characteristic of the game, she tried the recording of several games on the machine. After a week of trial recording, it was felt that it was possible to obtain a fairly accurate picture of that part of the technique of the game in progress which is directly connected with possession of the ball. This method, therefore, was adopted.

The groups selected for observation represented five high schools, and consisted of both intermediate and advanced sections. This selection was made in order that the results obtained might be truly representative of the basketball played by average high school girls, and not

the outcome of a particular style of coaching as found in any one school.

Because it was not feasible to interfere with the regular teaching program of the several schools, the checking had to be done during five and ten minute scrimmage periods in some cases, and during class games in others. Wherever possible, one record was made near the beginning and one near the end of the playing period. Observations were made weekly or bi-weekly over a period of eight weeks, and included a total of 256 minutes of playing time.

A typewritten copy of all the material recorded was made from the dictaphone records. These sheets were then underlined to facilitate accurate tabulation of the frequency with which various activities occurred. All shots at the basket were underlined in red, all passes in blue, and all interceptions in brown. Bounces were boxed in green and free throws in pencil. By running a ruler down the page, it was possible to detect with both accuracy and ease the particular element being recorded.

Tally sheets were constructed on which to check the frequency of occurrence, and the success or failure of the technical elements which had occurred. From the tally sheets the total frequency and the relative percentage of success were computed for each element.

The most characteristic technical elements of high school girls' basketball in order of frequency of occurrence are:

1. *Passing and catching*—chest, shot-put, overhead, double underhand, shoulder, bounce, and single shot-put, there being approximately 7 chest passes to every single shot-put pass, and 13 two-handed passes to every one-hand pass.

2. *Shooting*—chest, overhead, shot-put, and placed, with an average of 23 chest shots for every placed shot; source of ball prior to shooting, pass from center, pass from forward, bounce to self, and recovery from backboard, with approximately 3 shots after receiving a pass from center to every shot after recovery from the backboard; there is an average of only one shot at the basket attempted to every 4 passes used by the players.

3. *Play from out of bounds*—shot-put, chest, and overhead for the most part, followed by bounce, shoulder, single shot-put, and double underhand, with an average of 8 shot-put passes attempted to every double underhand.

4. *Intercepting passes*—by guards, centers, and forwards, with the guards intercepting 3 to the forwards' one.

5. *Recovering missed shots from backboard*—by guards and forwards, in the proportion of 8 to 7 in favor of the guards.

6. *Bouncing*—by forwards, centers, and guards, there being 6 by forwards to every one by guards.

7. *Tip-off plays*—there is an average of one tip-off play to every 10 passes attempted.

8. *Pivoting*—by forwards, centers, and guards, the forwards using 8 to every one by the guards.

9. *Free Throws*—chest and underhand in nearly equal proportion.

In every case, the elements listed under the main headings are also ranked in order of percentage of success.

The more frequently occurring technical elements ranked in order of percentage of success are:

1. *Individual activities*—pivots 97 per cent, bounces 85 per cent, interceptions 82 per cent.

2. *Plays from out of bounds*—bounce, chest, double underhand, shot-put, shoulder, single shot-put, and overhead, together giving an average of 79 per cent.

3. *Passing and catching*—chest, bounce, double underhand, shoulder, overhead, shot-put, and single shot-put, together giving an average of 70 per cent.

4. *Shooting*—chest, placed, overhead, and shot-put, together giving an average of 31 per cent; after bounce to self, pass from forward, recovery from backboard, and pass from center, the first being 38 per cent successful and the last 27 per cent.

5. *Free throws*—chest and underhand in nearly equal proportions, averaging 23 per cent.

The use of the dictaphone as a means of recording play by play activities in a game of basketball proved so successful that it is recommended for similar use in connection with other sports.

A logical sequel to the work presented here would be the construction of valid and reliable basketball tests. Going a little further along the same lines, it would be both interesting and worth while to set up standards of achievement in basketball technical elements for high school girls. After teaching to an experimental group the technical elements of basketball found in this study to have a high percentage of success among high school girls, and after teaching to a control group any material formerly used in coaching the game, it should be possible to compare the playing ability of the two groups. Such a study might aid materially in answering the question of whether or not detailed analyses of complex athletic games are worth while.

Grading Anteroposterior Standing Posture

ANTEROPOSTERIOR postural relationships in the erect standing position have been described, analyzed, measured, and evaluated with particular reference to college women and elementary school children. Several of the theses on this subject begin with an account of the adaptive changes occurring in the evolution of the upright position and during the growth of individuals from infancy to adulthood. Significant anatomical characteristics are discussed, and various types of posture defined. And finally, a valid and reliable method of grading posture has been developed. Arranged in chronological order this group of studies is as follows:

The Objective Evaluation of Standards and Types of Posture, Harriet P. Rawles '25.

A Study of the Factors Influencing the Posture of School Children, Frances C. Dennett '25.

Posture: A Consideration of the Anterior Posterior Relationships of the Parts of the Body, Carolyn Tarbell '28.

Chronological Variations in the Posture of Children Ages One to Seven and Ten to Thirteen, Katharine N. Maple '29.

An Objective Method of Grading Posture, Charlotte G. MacEwan '30.

An Objective Method of Grading Posture Applied to Girls of Preschool and Elementary School Age, Clarice N. Wade '30.

An Objective Method of Measuring the Antero-posterior Posture of Children of Elementary School Age, Katharine F. Wells '34.

Rawles, Dennett, Tarbell, Maple, and Wells each attempt to define the so-called "normal" or "ideal" posture in words before proceeding with various schemes of classification and measurement. The word "posture" denotes any "relative arrangements of the different parts of anything, especially of the body." These studies deal with erect posture in the "best" standing position.

Rawles systematically describes the structural features of the body segments that have a bearing upon their postural relationships—the mechanism of the foot; the hip, knee, and pelvic joints; the vertebral column; the thorax; and the muscular action needed to maintain the erect position. Optimum (not average) erect posture is discussed in terms of the relationship of the body segments to the general weight line of the body. There is no general agreement, however, as to what the relations should be, consequently there is a variety of opinion as to the definition of the optimum. A number of writers are quoted as to the characteristics of "good" and "poor" postures.

Dennett gives a rather detailed description of the body segments and the evolutionary history of the human skeleton which assumed the functions of support and locomotion in addition to the primary function of protection. The evolution of the erect body and the wide chest preceded the adaptation of the lower limbs to weight bearing and locomotion, and the ability to hold the head in an erect position is the most recent acquisition of all. After describing various types of posture, good posture is defined as a position in which the segments of the body are balanced vertically one upon the other so that the weight is borne mainly by the bony framework and the minimum of effort and strain is placed upon the muscles and ligaments.

Tarbell continues the discussion of the requirements of normal posture and of common deviations from the normal. Among the latter are flat back, sway back, hollow back, round shoulders, flat chest, forward head, abdominal relaxation, and winged scapulae. These features take on varying significance according to the age and sex of the individual.

Maple inquires further into the question of the postural characteristics which appear normally at different ages. The achievement of erect posture depends upon repeated efforts to cope with the forces of gravity and upon the development of skill in maintaining the equilibrium of the erect jointed body over a small base of support. Obviously the musculature of a child cannot accomplish what is expected from that of a young adult. The postural characteristics of children at different ages were reported by Maple as follows:

> One to three—forward head and neck, almost no lumbar curve, erect trunk, scapulae erect and on sides of chest.
>
> Four to five—head slightly forward, comparatively slight lumbar curve, erect trunk, prominent scapulae.
>
> Six to seven—head erect, sharp lumbar curve, erect body, prominent scapulae.
>
> Ten to thirteen—forward head and neck, comparatively flat lumbar spine, scapulae flat, body tilt marked.

It is evident that the postural characteristics of children do not conform to the standard of posture for adults, and that the age of a child in an indispensable factor in a consideration of his posture.

Wells gives a summary of opinions regarding the chronological trends in the anteroposterior posture of children as follows:

> *Spine.*—At birth the spine is slightly convex but tends to flatten during the first year. The cervical curve does not reach its full development until the sixth or seventh year. From then until adolescence the head is observed to tilt increasingly forward, but this is considered a posture fault and is not accepted as the normal tendency. The lumbar curve develops as the child begins to stand, and as hip joint extension produces tension on the iliofemoral

ligament and hip joint flexors. A straight upper back and moderate lumbar lordosis are characteristic throughout most of the pre-adolescent age, and the depth of the lumbar curve is in proportion to the prominence of the abdomen. During the adolescent period the spine acquires the curves of the normal adult spine. It is at this time that posture faults are most likely to develop and it is especially difficult to distinguish between real defects and a retarded transition to the adult posture.

Chest.—During infancy the chest is barrel-shaped, being much deeper in proportion to its breadth than it is a few years later. The transition to the broad, flat type of chest takes place during the preschool and early school years. Chests are widest in relation to their depth between the ages of eleven and fifteen (Bancroft). Later the chest becomes slightly higher as the sternum increases its outward slope.

Shoulder Girdle.—The position of the shoulder girdle is dependent upon the shape and position of the chest, the dorsal curve of the spine, the musculature of the shoulder girdle itself, and the inclination of the trunk. The scapulae of the preschool child are small, the clavicles are straighter and shorter than they are later in childhood, and the chest is more barrel-shaped. The scapulae, therefore, lie on the sides of the chest, more in the sagittal and less in the frontal plane. As the child grows older, and as the chest becomes broader and flatter, the scapulae draw closer together in back and lie in a more frontal plane. Failure of the scapulae to take this position by the time the chest has lost its infantile shape is usually due to an increased dorsal curve or to undeveloped posterior muscles and is to be considered a posture defect. By the close of the pre-adolescent period, the shoulders themselves, or more specifically, the acromion processes, should lie either in, or slightly posterior to the lateral midline of the body.

Abdomen.—The prominent abdomen of the young child is a typical feature of his posture. Authorities differ concerning the age at which the abdomen eventually becomes flat. Some say the age of five, six, or seven. Others suggest that the flattening may be postponed until nine or ten without being considered abnormal.

Pelvis.—The position of the pelvis is so dependent upon the position of the lumbar spine and the tone of the abdominal muscles that the degree of tilt corresponds closely with the degree of lumbar lordosis and of abdominal prominence.

Numerous methods of evaluating posture have been attempted and difficulties were encountered on every hand. It was found that the opinion of a single person, even though an expert, was not altogether reliable, i.e., experts did not altogether agree among themselves. The opinion of a *jury* of qualified judges was more valid and reliable, but obviously impractical for routine use. Objective measurements seemed for a time to be hopelessly inadequate, but finally a satisfactory technique was developed for the objective grading of posture from small profile photographs. Rawles, Tarbell, and MacEwan worked with college women; Wade and Wells with children.

Rawles obtained profile pictures of 300 college undergraduates and

made large tracings from the negatives. These tracings were graded by a committee of judges. Rawles then classified the tracings according to posture type and made composite pictures of each type.

The outline of the tracings graded "A" presents a marked impression of easy, graceful poise and balance not apparent in any other composite picture. The neck line in the back is straight and the dorsal and lumbar curves are slight, giving the suggestion of flexibility and strength. The head is held high but with no hint of strain. The chest is high but not to an exaggerated degree, the abdomen is flat, not relaxed, and yet not retracted with any evident muscular effort. As nearly as can be ascertained the vertical line passes through the ear, slightly in front of the glenoid cavity, in front of the bodies of the thoracic vertebrae, through the bodies of the lumbar vertebrae, the head of the femur, the center of the knee joint, and in front of the ankle joint approximately through the navicular bone.

Deviations from "A" posture were classified as type 1 if there was decreased inclination of the pelvis, as type 2 if there was increased inclination of the pelvis, and as type 3 if there was a normal inclination but variations elsewhere.

The "B" grades of the three types do not fall far short of the "A" standard. In B^1 the most marked differences lie in the lower chest and the slight shifting of the weight backward. Conversely B^2 has a high chest, increased pelvic obliquity, and increased curve in the upper back, and shows a slight shifting of the weight forward. B^3 is characterized by slightly increased dorsal and lumbar curves, and the head and chest are not so high as in the preceding.

A slight relaxation is apparent in all types of "C" posture. The general effect of poise in type C^1 is fairly good, but there is an evident increase in the curves of the back and neck. In C^2 the weight is slightly forward and the knees are almost hyperextended. The vertical passes behind the ear, through the shoulder, probably behind the bodies of the lumbar vertebrae, the trochanter and the center of the knee joint. The chest is higher than in C^1 but lower than the ideal, and the pelvic obliquity is greater. The variations in type C^3 appear in the low chest angle and the increased convexity of the upper thoracic spine.

A marked slump is evident in type D^1. The weight is carried somewhat backward above the waist, but due to a slight flexion in the knees it falls largely on the balls of the feet. The dorsal curve of the back is quite noticeable, and the pelvic inclination is low. The head is forward, the chest low, and the abdomen relaxed. In D^2 as in C^2 the chest is low, the pelvic obliquity increased, and the upper back curve increased.

The E types of posture fall almost into the pathological category. In E^1 the chest is very low, the head forward, the lumbar curve decreased, the upper back curve decidedly increased. The abdomen is

relaxed to a marked degree of ptosis. In the second type the chest is high, not so much because it is lifted, as because the upper part of the trunk is shifted sharply backward. The lumbar curve is very marked, the upper back curve considerably increased. The abdomen is noticeably ptotic, the hip joint flexed and the knees hyperextended.

Rawles also attempted to measure the height of the chest and the angulation of the body segments. The general congruity between the subjective ratings and the grades derived from the angular measurements seemed to indicate not only that the latter might serve as the basis of an adequate objective grading method, but also that the subjective ratings and the type subdivisions were logical and consistent.

Tarbell studied the pictures of 235 entering students who had been graded good, fair, or poor on the basis of orthopedic findings, carriage, anteroposterior conditions, and ease of correction. On the profile photographs, lines were drawn along the central axis of the neck, the profile of the shoulder blade, the central axis of the trunk above the waist, and along the profile of the upper part of the sacrum. The angles made by the first three of these lines with the vertical, and that made by the last with the horizontal were added to give the posture grade. This scheme was far from satisfactory because the lines were not drawn from clearly determined anatomical landmarks.

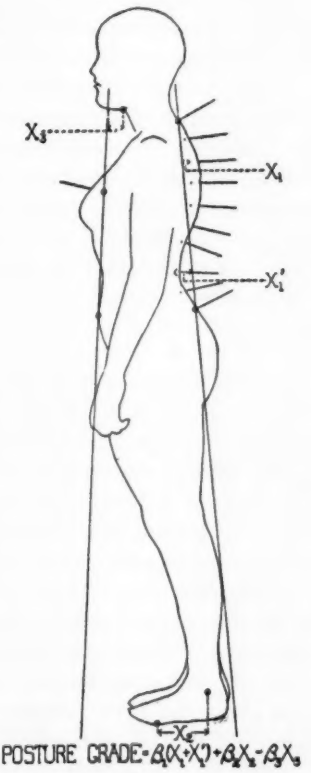

FIG. II.—Diagram showing location of points and lines used in grading the posture photograph. (See p. 84.)

MacEwan overcame this difficulty by determining in the photograph the actual position of the lower end of the sternum and the line of spinous processes from the seventh cervical vertebra to the sacrum with light weight aluminum pointers, and by marking the center of the external malleolus of the ankle joint with a bit of adhesive tape. Her "Objective Method of Grading Posture" has been reported at some length in the RESEARCH QUARTERLY of October, 1932 and in the

Physiotherapy Review, September-October, 1935, so it is not necessary to present it again in detail. The practical usefulness of her front and back lines as planes of reference for the measurement of the back curves, the relationship of the head, chest, and abdomen, and the distribution of weight over the feet (see Fig. II) is established by the fact that she obtained a correlation of .812 between the objective posture grades and the ratings of a jury of qualified judges (Miss Sarah Russell Davis, Miss Lillian Curtis Drew, Miss Ruth Glassow, Miss Louisa Lippitt, Miss Josephine Rathbone, and Miss Leah Thomas). After reading MacEwan's critical review of previous work, one is impressed with the difficulty of working with angles and with the measurement of deviations from any specified vertical.

Copies of the 858 profile pictures of "best" standing position used by MacEwan in 1930 have recently been prepared and sent to a large jury consisting of artists, concert dancers, orthopedic physicians, instructors of individual gymnastics, and instructors in the general physical education activity program as well as to members of the original jury. It is our intention to analyze the opinions of judges and groups of judges and to secure a stronger criterion of posture. The next step is to re-work the whole problem of grading from objective measurements and revise the grading scale accordingly.

Wade dealt specifically with the problem of applying the MacEwan method of grading to girls of preschool and elementary school age. She used aluminum pointers to mark the line of spinous processes from the seventh cervical vertebra to the sacrum, obtaining profile photographs from 209 girls between the ages of two and fourteen.

On the enlargements of these pictures a back line was drawn through the foot of the seventh cervical pointer and the foot of the sacral pointer as in the MacEwan study (cf. Fig. II). A front line was drawn through the end of the manubrium and the point of greatest abdominal prominence. The mid-point between these two lines at the level of the sole of the foot was determined, and the distance of this point from the head of the fifth metatarsal measured. This was taken to be a measure of weight distribution over the feet. The degree of abdominal protrusion was measured by the horizontal distance of the abdominal profile from the vertical erected through the juncture of the front profile of the thigh and trunk. The position of the head and neck was indicated by measuring the horizontal distance of the jaw-neck angle from the front line. The depths of the dorsal and lumbar curves were measured from the back line. The horizontal distance between the lower angle of the scapula and the dorsal curve was measured, also the angle which a line joining the superior and inferior angles of the scapula makes with the vertical. The posture criterion was obtained by averaging the subjective ratings of three judges.

Zero order correlations with the criterion were as follows:

Variable	r	Variable	r
Sum of depths of spine curves	.342	Scapular tilt	.261
Weight distribution over feet	.459	Age	.241
Position of head and neck	−.466		

A six variable partial correlation problem was worked out to determine how these factors should be combined to give the best possible objective measure of posture. From the special form of the regression equation it was found that all the factors are of about equal importance with the exception of age which contributes less than a fifth to the final result. The coefficient of multiple correlation (.738) was not as good as that obtained by MacEwan for college women (.812).

There were no marked trends from one age group to the next with respect to the measurements taken. Slight variations appear in the distribution of weight, the prominence of the abdomen, and the scapular tilt. However, when the subjects were classified as good, fair, and poor, and compared with similar groups of college students, the measurements in millimeters on a standard enlargement (spine length=13 cm.) show the following interesting trends:

	Adult			Children		
	Good	Fair	Poor	Good	Fair	Poor
Depths of Curves	8.10	11.23	13.26	11.60	14.15	16.03
Neck	13.96	10.40	5.03	8.10	3.83	.30
Weight	−5.33	−16.13	−20.30	−37.00	−57.76	−73.21
Abdomen	2.80	4.00	4.10	17.73	17.86	17.38
Scapular Tilt	6.33	8.30	8.16	11.36	12.13	14.33

Notice that the degree of abdominal protrusion is quite constant in both the adult and children's group, and that it does not seem to vary significantly with the postural classification.

Wells made a more extensive study of children's posture, using essentially the same technique as Wade. Posture photographs were taken of 519 children (369 girls and 142 boys) ranging between the ages of six and thirteen. The criterion scores were obtained by totalling subjective ratings from the following: Miss Claire Colestock, Miss Sarah R. Davis, Dr. Helen Denniston, Dr. C. L. Lowman, Dr. A. R. MacAusland, Miss Janet B. Merrill, Miss Josephine L. Rathbone, Dr. F. H. Richardson, Dr. Arthur Steindler, Miss Leah C. Thomas, and a committee of three instructors from the Merrill-Palmer School. These judges were also asked to answer a questionnaire as to what factors were to be considered in judging posture, what variations were to be

expected due to age and sex, etc. A few of the answers are summarized below:

1. *Factors to be considered in judging posture.*—
   Body type—7 judges.
   Alignment of body segments and relation to gravity—6 judges.
   Correctability—5 judges.
   Muscle tone—3 judges.
   Mention was also made of flexibility, nutrition, vitality, and age.

2. *Order of importance of factors listed.*—
   Alignment of body segments and their relation to the gravity line.
   Lower back.
   Upper back.
   Abdomen.
   Chest.
   Head and neck.
   Freedom from tenseness.
   Position of scapulae.
   Knees.
   Arches of the feet.

3. *Variations due to age and sex.*—
   Scapulae—tilted and abducted in young child.
   Thoracic curve—no agreement.
   Lumbar curve—exaggerated during childhood.
   Abdomen—normally prominent in small children, more prominent in girls.
   Inclination of pelvis—no agreement.

4. *Feasibility of setting up a standard of posture for boys and girls of each age group.*—
   Yes—5.
   No—3.
   No answer—3.

5. *Definition of good posture in the erect standing position.*—
   Varied answers, but most of them stressed the readiness and mechanical efficiency of a position in which the segments are well balanced, i.e. in good alignment relative to the line of gravity.

The degree to which the judges agreed in their grading was shown by correlating the ratings of each judge with the composite score. The highest coefficient for any judge was .860, the lowest .646. When analyzed by age groups it was found that there was less agreement in the case of the younger children.

In a preliminary study of twenty-five cases from each of four age groups (6–7, 8–9, 10–11, 12–13), three groups of data were obtained and correlated with the criterion.

	r
1. The MacEwan-Wade Measurements	
Depth of dorsal curve	—.366
Depth of lumbar curve	—.282
Weight distribution	—.609
Position of head and neck	+.483
2. Vertical Line Test Measurements (horizontal distance to vertical through base of fifth metatarsal)	
Ear	—.085
Neck-chin angle	+.151
Acromion process	—.069
Chest	+.225
Dorsal convexity	—.213
Lumbar concavity	+.222
Abdominal prominence	—.199
Knee	—.092
3. Additional Factors	
Height	+.194
Trunk-height ratio	+.183
Scapular deviation	—.007
Scapular tilt	—.012
Spread of front and back lines	—.400
Convexity length-spine length ratio	+.002
Age	+.223

A partial correlation problem was then worked out for 511 cases using the four MacEwan measurements and age as the variables. The coefficient of multiple correlation was .700 which is much lower than that obtained by MacEwan for college women (.812) and slightly lower than that obtained by Wade for girls (.738).

Although the correlation between age and posture was low (.167 for the whole group) certain chronological trends are evident. The dorsal curve shows a gradual increase from the age of six to the age of thirteen, but the lumbar curve increases only until ten or eleven, and then decreases slightly. The alignment of segments and body tilt, as shown by the weight distribution measurement, improves steadily with age, and to a very noticeable degree. The measurement showing the relationship of the head, chest, and abdomen also improves consistently as the ages increase.

The only outstanding difference observed between the posture characteristics of boys and girls is that of weight distribution. This factor is poorer in girls. There is also a slight difference in the lumbar concavity, this being greater in girls at all ages.

Both from the stated opinions of the judges and the special form of the regression equation it is observed that the outstanding factors in the posture of children may be arranged according to importance as follows:

Alignment of segments or weight distribution.
Position of lower back.
Position of upper back.
Head, chest, abdomen relationship.

In conclusion it may be said that the MacEwan method of grading posture objectively may be successfully applied to children of elementary school age, in spite of chronological differences. The method does not, however, lend itself to routine use in the average school.

Now that we have reliable measures of certain postural relationships it would be most timely to inquire further into the "goodness" and "poorness" of the various types of posture. On the one hand we find such statements as these: "We have as yet to obtain definite proof of the mechanical, anatomical, and physiological advantages of certain postures over others, which might appear on the surface to be equally good (Todd)," and "Until more studies have been conducted to prove that a relationship exists between posture and health, vital capacity, intelligence, leadership, etc., it does not seem that statements, similar to those quoted in this paper, should be made by physicians or physical educators (Deaver)." On the other hand there is considerable evidence that good posture is significantly related to health and efficiency, (Schurmeier, Hoffa)[1] but we note that none of these writers used adequate methods of judging posture.

[1] H. L. Schurmeier, "A Consideration of Posture and Its Relation to Body Mechanics," *American Medicine*, (March., 1927) p. 143.
Elizabeth Hoffa, *The Relation of Posture to Body Build, Health and Efficiency*, (Hamilton House, London, Ling Association, 1936).

Factors in Anteroposterior Posture

ATTEMPTS to determine the factors responsible for good and poor anteroposterior posture and for posture changes during the course of a two-year college program in physical education activities have been made by the following:

The Objective Evaluation of Standards and Types of Posture, Harriet P. Rawles '25.

A Study of the Factors Influencing the Posture of School Children, Frances C. Dennett '25.

Trunk Strength and Flexibility as Factors in Posture, M. Elizabeth Powell '30.

Endurance of Abdominal and Neck Flexor Muscles as a Factor in Posture, Helen R. Clarke '31.

A Study of the Posture Training Value of Various Activities, Sylvia J. Burt '31.

A Study of Relationships Between the Changes in the Position of Body Segments When "Natural" Standing Position is Altered to "Best" Standing Position, Grace R. King '32.

A Study of the Posture of College Undergraduates, Esther L. Spargo '33.

The Relation of Directed Physical Education Activities to Posture Improvement, Isabelle M. Kirch '33.

An Analysis of the Changes which Occur in the Posture of Wellesley College Students with Special Reference to Those Who Receive a Superior Grade on Entrance, Selena R. Knight '35.

A Study of the Measurement of the Anteroposterior Gravity Line and Its Relationship to Posture, Barbara B. Johnston '35.

The Reliability of the Anteroposterior Gravity Line Measurement and Its Relationship to Posture, Mary G. Crowley '36.

In the Rawles study, which has already been mentioned in the previous section, data from the orthopedic and medical examinations were recorded for each of 300 subjects. Total strength, motor ability, and intelligence were also noted. It was found that underweight students had the greatest number of physical defects. The same is true of those with low chest, pronated ankles, forward shoulders, and relaxed abdomen. In general, a history of cardiac and pulmonary affections accompanied poor postures of type 1 (decreased inclination of of the pelvis), whereas dysmenorrhea, constipation, pain in the back, and poor postural conditions of the feet accompanied type 2 (increased inclination of the pelvis). In this college group practically no correlation existed between posture and vital index, strength index, motor ability, or intelligence.

The inference is that claims for good posture should be based upon

the physical, social, and aesthetic relationships of posture and not upon performance efficiency, physical or intellectual. The significance of posture in relation to organic and structural defects alone is sufficiently obvious, even in the incipient stages, to justify heavy emphasis on the advantages of good posture.

Dennett's study of the factors influencing the posture of school children was obviously handicapped because no satisfactory method of grading posture was available at that time. The posture tracings of the 124 children examined were judged subjectively by a competent and experienced person (Dr. Skarstrom). These were also graded objectively by the Goldthwait method and by totalling the angles made by the length axes of the body segments. The three sets of grades did not correlate very highly (Skarstrom-Dennett .69, Skarstrom-Goldthwait .26, and Goldthwait-Dennett .34).

The factors studied in relation to posture were nutrition, anatomic type, feet, general organic function, strength, educational age, sex, clothing, school furniture, and family example. Nutrition was measured by the Dreyer, Baldwin-Wood, and Pirquet methods; body type by the ratio of sitting to standing height, and the ratio between breadth of shoulders and sitting height; strength by the Martin test and Martin strength-weight index; and fitness by the Schneider test. None of these measures correlated significantly with the subjective posture grades. There was, however, a correlation of .37 between posture and a rating of foot condition and a correlation of .36 between posture and educational age.

Studies of strength, flexibility, and endurance as possible factors in posture were made by Powell and Clarke. Niels Bukh attributes the faults in the upright carriage to the lack of mobility of the spinal column, especially in the convexities forward in the neck and lumbar regions and backward in the thoracic region, and to unequal muscular development which in turn produces exaggerated spinal curves.[1] He speaks of certain muscles as being weak and of too great length in their mid-position as they are stretched over the somewhat increased bony convexities. McCurdy says that good posture depends upon sufficient length of ligaments and muscles (i.e. one element of flexibility), and upon adequate strength of opposing muscles with proper relative tone. Kellogg has shown that in persons whose posture is habitually bad, the three great groups of trunk muscles—anterior, posterior, and lateral—are disproportionately weak. Observations by Stafford support the view that even small differences in strength are sufficient to cause larger differences in the ability and inclination of a person to maintain good posture.

Powell selected subjects who received very good, very poor, and

[1] Niels Bukh, *Primary Gymnastics*, (London, Methuen, 1925) p. 5.

intermediate ratings by the MacEwan jury of posture judges. "Breaking point" strength tests were devised for measuring the strength of the upper back extensors, neck and head extensors, head and neck flexors, and abdominals. The combined action of the anti-gravity trunk muscles was tested by means of a head push-up against a dynamometer. The Martin Short Test and the Sargent Jump were also given. Using aluminum pointers to mark the chest and spine, four profile photographs were taken of each subject—the habitual standing position, the best standing position, maximum spine flexion with support at the hips, and maximum spine extension with support at the thighs and head (see Fig. III).

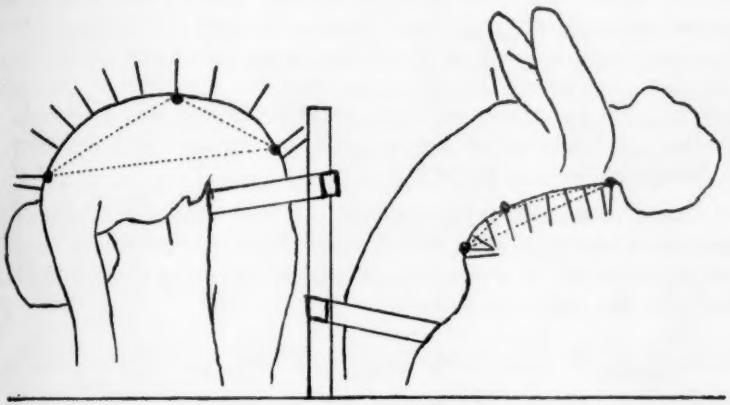

FIGURE III. The measurement of flexion and extension in the spine.

On the enlarged tracings of these profiles, lines were drawn joining the bases of the seventh cervical, twelfth thoracic, and sacral pointers. The depths of the curves were measured from these lines. The range of flexibility was the difference between the forward bend and backward bend positions. From the habitual standing position, flexibility forward and flexibility backward were determined.

It was found that strength in general was not a factor in posture, although neck flexion strength gave a higher coefficient of correlation with posture than other measures of strength:

Strength Factors	*r*	P.E.
Neck Flexion Strength	.246	.067
Martin Short Test	.207	.068
Pushup Dynamometer	.169	.069
Trunk Strength Total	.140	.070
Abdominal Strength	.112	.070
Neck Extension Strength	.058	.071
Upper Back Strength	.049	.071

The very fact that the upper back muscles have a greater load when the posture is poor would tend to strengthen them in a long position. In poor posture the neck flexors and abdominal muscles are relaxed and do not support their share of the body weight, the load that they should carry being transferred to the back muscles and to the ligaments.

The ratio of trunk strength to the Martin strength score is about the same in the good and poor posture groups. This is contrary to Kellogg's findings.

The total flexion-extension range of motion in the spine was about the same for the good and poor posture groups. However the poor posture group had more possible thoracic flexion and less possible thoracic extension than the good group. Also from the habitual position, the poor group had a greater percentage of possible movement in the direction of straightening the curves than the good group. This would indicate that the degree of muscular effort in specified directions, regardless of fundamental improvement in strength and flexibility, is a significant factor in posture.

Clarke devised an ergograph for the study of the endurance of the neck flexor and abdominal muscles. She also used the "sit-up" and the Martin short test. The correlations with posture as graded by the MacEwan method were as follows:

Variable	r	P.E.	Variable	r	P.E.
Sit Up	—.364	.10	Martin Strength	—.208	.11
Abdominal Endurance ...	—.252	.11	Neck Endurance	—.181	.11

The negative coefficients are logical since the best posture scores are low and the best strength and endurance scores are high.

Johnston and Crowley have made experimental studies of the anteroposterior gravity line and its relation to posture. They used apparatus similar to that of Wickens.[2] The subject stood on a board which was supported at either end on a metal edge. One edge was in turn supported by the floor and the other by the platform of a Fairbanks or Chatillon scales. Knowing the person's total weight, the horizontal distance from his internal malleolus to the two knife edges, and the partial weight as measured by the scales under the front end of the board, the location of the gravity line in the median plane of the body could be computed.

Johnston found that the gravity line determinations were fairly reliable when the measurements were made in quick succession (self-correlations .562 to .910) but that even the averages of four readings

[2]J. S. Wickens. *"The Center of Gravity of the Human Body in the Anteroposterior Plane and Its Relation to Posture,"* Thesis, Springfield College, 1934.

taken a month apart did not prove to be reliable (.221 to .406). This is contrary to the results obtained by Wickens.

In the case of 103 freshmen and sophomores the gravity line was 7.7 cm. in front of the internal malleolus in the "best" standing position, and 6.7 cm. in front of the malleolus in "habitual" standing position. The average deviations in the series of four determinations were from .4 cm. to .6 cm. Comparable results were obtained when three students were tested on the Wickens apparatus at Springfield.

No significant relation was found to exist between weight distribution as measured by the gravity line test, and posture grade or motor ability.

The study of the gravity line test was continued by Crowley who tested each subject three times, each test consisting of four determinations for best standing position, four for habitual standing position, and the same was repeated with fixation of the eyes. She found that the gravity line fell as far in front of the malleolus as 9.7 cms. and as far behind it as .4 cm. with an average of 4.35 cms. The position of the line of gravity was found to vary as much as 2.79 cms. during the day in a single individual. Sway as measured by average deviations from the mean is great, but is reduced somewhat by fixing the vision. The reliability of the test over a long period of time was only fair and the gravity line measurement showed no significant relationship to height, length of foot, or posture as measured by the MacEwan method.

Using one hundred pairs of photographs taken by MacEwan (one of the "best" and one of the "natural" standing position of each girl), King made an interesting statistical study of changes in segmental relationships when "natural" standing position is altered to "best" standing position. The difference in posture grade was the criterion score. Improvement in posture grade was associated with the following changes, given in the order of importance:

Variable	r	P.E.
Forward movement of the chest accompanied by flattening of the abdomen (Horizontal deviation of front line)	.797	.025
Straightening of the upper back	.638	.040
Flattening of the abdomen alone	.509	.050
Raising of the chest alone	—.357	.059

Significant intercorrelations were found between changes in the various relationships as follows:

Variables	r	P.E.
Hips and Knees	—.774	.027
Abdomen and Horizontal Deviation of Front Line	.584	.044
Upper Back and Chest	—.500	.051
Upper Back and Horizontal Deviation of Front Line	.493	.051
Upper Back and Lower Back	—.426	.055
Chest and Horizontal Deviation of Front Line	—.300	.061
Lower Back and Chest	.297	.062

The common practice of giving attention to the relationships between upper and lower back and chest position rather than to the separate parts, is given independent, statistical confirmation in the zero order and partial correlations between these variables.

From the point of view of the teacher of physical education, leadership in the direction of ideal posture for every individual involves the teaching of posture skills, habits, and appreciation. The work of Burt, Spargo, Kirch, and Knight has given us an insight into the posture history of Wellesley undergraduates and some idea as to the effect of directed physical education activities upon posture improvement. A partial report of these studies was published in the RESEARCH QUARTERLY of March, 1935, so only brief comments and quotations will be made here.

From Burt's summary of the posture training value of various activities it appears that on the whole no very strong support is given to the theory of differential posture values in the activities of a program of physical education. However, when a group having fall posture grades between 11.0 and 13.5 (MacEwan scale) was selected from each activity, the improvement in the spring showed Individual Gymnastics leading, Fundamental Gymnastics and Interpretative (now Modern) Dancing tied for second place. Folk Dancing was next, while Clogging and Tumbling made only slight improvement. These results can be accredited to the posture training value of the activity in as much as these were groups having the same grade to begin with in the fall. It is interesting to note that students in Individual Gymnastics made the largest average net improvement in all three elements of the posture grade, but the greatest was made in the "Deviation of the Neck from the Front Line."

After reviewing the literature on factors in posture, Spargo says, "There is, however, a current of opinion in favor of the possible effectiveness of general and special forms of physical education in the direction of lasting posture improvement." Spargo used data from the routine physical examinations for her study of posture changes in three groups of students. Part of the posture improvement is attributed to instruction in posture at the time of the physical examination and to

a better understanding of the procedure, and part to physical education activities. Failure to maintain all of the posture improvement which occurs during the freshman year indicates that factors other than activity and a knowledge of body mechanics are concerned.

Kirch obtained data to show that there has been consistent improvement in the mean posture grade of the entering classes at Wellesley —from 12.34 for the class of 1934 to 10.37 (on a scale of 25 in which smaller scores represent better postures) for the class of 1936; also that the posture grades of Wellesley freshmen were better than those of Minnesota freshman (10.37 at Wellesley, 14.34 at Minnesota for the class of 1936). Among Wellesley College students there was a marked improvement from entrance to the spring of sophomore year, a falling off in grade from the spring of the sophomore year to the spring of the junior year, and a slight improvement during the following year. Participation in extra-curricular physical activities appeared to have no effect on this trend.

Kirch found that there was a curvilinear relationship between initial posture grades and improvement, the lower the initial grade, the greater the amount of improvement to be expected during the course of a year's work in physical education. When the usual amount of posture instruction was omitted there was very little improvement. The Pameter (Posture Achievement Meter, described in the RESEARCH QUARTERLY for March, 1935, and also a little later in the *Physiotherapy Review* for September-October, 1935) was constructed around the improvement curve in such a way that units of expected variability (P.E. values) are shown above and below "par" for the full range of initial posture grades. With this device it is possible to grade the posture achievement for individuals or for groups.

Knight continued the discussion of factors influencing posture and the study of posture trends among Wellesley College students, particularly those who received posture grades of "A" upon entrance.

The class of 1935 was an especially interesting one to study. In the first place, its freshman year was an experimental year when all posture instruction, except that which is inherent in the activities themselves, was omitted from the program of physical education. In the second place, this class was the first to be affected by the C— minimum requirement for the completion of department credit for freshman and sophomore activity courses. Regardless of the fact that all posture instruction was omitted during its freshman year, the class of 1935 made a net improvement of 1.70 points. However, comparing this to the 4.02 points of improvement shown by the class of 1934 and the 2.29 points by the class of 1936, one can see that the class of 1935 did not make the expected improvement. On the other hand, during the sophomore year with the advantage of regular posture instruction, this class made

an improvement of 1.43 points, whereas the class of 1933 showed a decline of .05 points. This brought the means of the two classes to about the same achievement level at the end of the sophomore year, proving very definitely that the posture instruction given as an adjunct of the activity program at Wellesley College is effective. Of the 260 students whose posture was studied, only six failed to meet the C- requirement at the end of the sophomore year.

When the fall posture grades were plotted against improvement, it was discovered that those having fall grades of six or better tended to make negative improvement. A small amount of variability is to be expected, but this does not explain the prevalent decline from high initial grades. Upon further analysis it was found that unfavorable changes in segmental angulation and body tilt appear to be largely responsible for the net loss in the "A" posture group, whereas this factor was negligible when the class of 1935 as a whole was considered.

The 46 students of the class of 1938 who received "A" posture grades upon entrance in the fall were divided into two groups. The experimental group received special posture instruction, the other group served as a control. The mean posture grade of the experimental group was raised 1.61 points while that of the control group suffered a decline of 2.12 points. The big difference of 3.88 points between the means of the two groups proves rather conclusively that suitable posture instruction to individuals with "A" posture is effective in bringing about improvement. The danger of overcorrection is of course greater in the case of students entering with good or excellent posture than it is in the case of students with fair or poor posture. Strain and tenseness is often present in students whose objective posture grades are high. Ease in carriage should be emphasized in the case of these individuals even though the objective posture grade is not quite so good.

Knight's technique of basing posture instruction upon scrutiny of the posture picture, study of the elements of the objective grade, observation of the student, and a knowledge of kinesiology and practical body mechanics illustrated very nicely how to apply various resources in the solution of individual posture problems.

Postural Relations in Walking

FROM a practical point of view, posture work in physical education extends beyond the teaching of the so-called "best" standing position. Efforts are made to influence habitual posture and carriage. Kelly and Thompson have developed techniques for obtaining profile photographs of inattentive or habitual standing posture, and for taking moving pictures of gait as the subject walked on a treadmill. The subjects were prepared with spine pointers and ankle mark as for the routine posture picture.

In Ellen Kelly's "Study of the Relation of Standing Posture to Habitual Carriage" (1932) a jury of eight judges discussed the points to be considered in rating carriage. It was agreed that the following should be observed:

Use of feet—pronation, toeing out.
Knees—interference, bow legs.
Body balance and poise, inclination of trunk.
Position of head.
Length of stride in proportion to height of the individual, thrust of leg.
Smoothness or grace of movement.
Symmetry of movement.

No attempt was made to define carriage or to make any arbitrary decision as to which characteristics should be graded high and which low. It was decided that a consideration of the posture of the individual should be included in the ratings of carriage.

The films showing the subjects walking on the treadmill were rated on successive days, and the film was shown twice each day. Four ratings, therefore, were obtained from each judge as to both posture and carriage (with posture included as an element in carriage).

Another rating of carriage was given as part of a motor performance test in the gymnasium. Dressed in regulation gymnasium costume, each student walked a distance of 100 feet in profile. This walk, from the subject's point of view, was merely to reach the starting mark for an obstacle race. Most if not all of the subjects were entirely unaware of the fact that they were being watched and graded on their carriage.

The average intercorrelation of ratings among the eight judges for carriage as shown by the moving pictures was .582, the average for observations made in the gymnasium was .380. The correlation between the scores obtained from the film and those from the gymnasium test was .002. The three most reliable judges were then selected, and the composite T-score of their film ratings was used as the measure of carriage. This measure of carriage correlated as follows with various grades of standing posture.

April (routine examination) best standing	.444
September (author) habitual standing	.348
September (routine examination) best standing	.023

Intercorrelations for these various posture grades were:

Best and Habitual standing (author, September)	.394
Best standing (author, September) and routine (April)	.462

From these results it appears that there are small but significant relationships among the three factors: best standing posture, habitual standing posture, and carriage.

Charlotte Thompson's "Study of Posture in Walking" (1933), was an attempt to evaluate walking from the postural standpoint on the basis of the MacEwan objective grading scheme, and to determine the relationship of posture in walking to other postural criteria.

Moving pictures were taken at slow, medium, and fast speeds on the treadmill. A few practice steps were permitted with each change of speed until the walking appeared to be as natural as possible.

The films were projected and graded by a jury of judges, and then by measuring tracings of selected "frames" on an enlarged MacEwan scale. By restricting the grading to "carriage from the postural standpoint" it was possible to secure a greater degree of unanimity among the judges than in the preceding study (.720 for the average intercorrelations among the judges as compared to .582). The correlation of subjective and objective grades was .696. This coefficient is comparable to the .812 obtained by MacEwan when subjective and objective grades of standing posture were correlated. Data secured from walking at medium speed on the treadmill were considered to be more valid and reliable than those secured from walking at slow or fast speeds. The composite grade for all three speeds was used in studying relationships with other factors.

A correlation coefficient of .619 was found for the relationship between the objective walking grade and *natural* standing posture (picture taken just before walking on the treadmill). Coefficients of .543, .398, and .260 were obtained when the objective walking grade was correlated with *best* standing posture at the time of the walking picture, routine fall, and routine spring best standing postures, respectively. These results do not confirm Kelly's contention that carriage grades are more closely related to spring posture grades than to those taken in the fall. They do, however, support the idea that natural or habitual standing posture is more closely related to carriage than the best standing position. When walking posture was correlated with motor ability scores the coefficient was .108.

It was suggested that additional methods be found for judging posture, and that the study of carriage be continued, including factors other than posture.

Lateral Curvatures of the Spine

THE Relationship Between Variations in the Anteroposterior Curves of the Spine and Scoliosis" was studied by Loraine Frost in 1929, before the MacEwan method of grading anteroposterior posture had been developed. Frost's data were obtained from 100 Wellesley College undergraduates of the classes of 1931 and 1932. All showed some degree of scoliosis and included almost every type from the mild total curve to the very severe curve with extreme rotation deformity. Profile and rear view photographs were taken in the nude, bilateral weight distribution measurements were made directly on the subject, and brief case histories were recorded.

Preparatory to taking the profile photograph, eight aluminum pointers like those used by MacEwan were placed along the mid-line of the back from the seventh cervical to the fifth lumbar vertebra. These standard length pointers made it possible to locate the anteroposterior curves of the spine on the photograph. The back view photograph was taken after the spinous processes from the seventh cervical to the fifth lumbar vertebra, the inferior angles of the scapulae, and the posterior iliac spines had been marked with a black skin pencil. The presence of rotation was observed with the subject in the flexed standing position. When the rotation was judged moderate or severe a photograph was taken. Weight distribution measurements were made by the Reynolds and Lovett method.

The side and back view photographs were projected to life size on a screen and the curves traced on coördinate paper. The anteroposterior curves were traced over the lateral, with the seventh cervical point of the two tracings coinciding. The weight line on the side view was made to coincide with a vertical line on the paper. The amount of deviation of both the anteroposterior and the lateral curves was measured by means of the squares on the coördinate paper.

The anteroposterior curves were classified by three competent judges as normal, increased, or decreased. Frost recognized the fact that this subjective judgment of anteroposterior posture was the weak point in her study. It appeared, however, that variations from the normal in anteroposterior curves were more prevalent among students with scoliosis than in an unselected group. Whether the deviation in one plane causes the deviation in the other, or whether the two occur more or less simultaneously as the result of a common cause is not revealed. A review of the literature on the subject shows a divergence of opinion. Frost suggested that a study similar to hers, but made on a younger group, preferably from 8 to 12 years of age, would be more likely to throw light on the primary, causative factor in this relationship.

That Frost has continued to have an active interest in the subject of posture is indicated by her recent report on "Individual Structural Differences in the Orthopedic Examination" (*Journal of Health and Physical Education*, February, 1938).

Barbara Andrews' "Objective Method of Measurement of Scoliosis and its Application in Thirty-one Case Studies" (1937) proposes a method of measuring and recording scoliosis that is sufficiently accurate for general purposes, yet simple and inexpensive enough to be used in routine physical examinations. Obviously some objective method is useful in judging the severity of the scoliosis and in measuring improvement after a period of treatment.

The data for each subject included back view photographs with skin pencil markings as in the Frost study, a direct measure of weight distribution over the two feet, the subjective record made by the orthopedic examiner at the time of the entrance physical examination, and items of personal and medical history.

The photographs were studied and measured for the purpose of revealing lateral weight displacement of the trunk, lateral deviation of the spine, rotation of the spine, asymmetrical hip prominence, and asymmetrical shoulder height. These measurements were then compared with the corresponding items in the orthopedic record, and in the case of weight displacement, with measurements made directly on the subject.

Lateral displacement on the photograph was judged by erecting a vertical from the mid-point between the heels and noting the horizontal deviation of the seventh cervical vertebra from this line. The orthopedic examiner let a plumb line fall through the gluteal fold and noted the relation of the trunk as a whole to this vertical. To find the division of weight over the feet the subject stood with one foot on the scales and the other on a lightly movable platform corresponding to the platform of the scales. The amount of agreement as to the absence, presence, and direction of lateral displacement was as follows:

Orthopedic examiner and photograph	61.3 per cent
Orthopedic examiner and scales	51.6 per cent
Photograph and scales	48.4 per cent
All three methods	35.5 per cent

These figures show decided unreliability but fail to indicate the comparative merits or weaknesses of the three methods. Andrews felt that there would have been better agreement between the photographic and direct scale measurements if the picture could have been taken at the same time, as the scale readings, also if disalignment of the pelvis rather than of the seventh cervical vertebra had been noted.

The lateral deviation of the spine was measured by slipping the

photograph under the glass used in the MacEwan method of grading anteroposterior spinal curves, and measuring (in terms of scale units which for this purpose are of course purely arbitrary) the horizontal distance between the apex of the curve and a straight line which connected the seventh cervical with the fourth lumbar vertebra. In comparing the type of curve as found by this method with the type recorded by the orthopedic examiner, there was found to be 80.6 per cent agreement. The fact that the subjects were not all examined by the same examiner seemed to account for much of the 19.4 per cent disagreement. The reliability of the deviation measurements was found to be satisfactory (repeated photographs gave nearly the same results). It is interesting to observe that several secondary curves which went unnoticed by the examiner were detected upon the photographs.

The presence of rotation was determined on the photograph of the flexed figure by holding a steel straight edge across the back at right angles to the vertical. It could then be seen whether one side of the back were higher than the other. The records made by this method and those of the orthopedic examiner agreed in 61.3 per cent of the cases. Seven cases of rotation, discovered by the photograph, were not noticed at all by the examiner.

Hip prominence was judged subjectively on the photograph in practically the same manner that it was judged directly on the subject by the orthopedic examiner. Possibly it was this very similarity of method that accounted for the 93.5 per cent agreement between the two.

Difference in shoulder height was judged subjectively, as rotation was, with the aid of a straight edge held across the picture. The records made by this method and those of the orthopedic examiner agreed in 67.8 per cent of the cases. Andrews felt, however, that any record of shoulder asymmetry was unreliable because she found that the subjects tended to shift their shoulders without realizing that they were doing so. Even the photograph cannot be relied upon because when the shoulder girdle is twisted, as it frequently is in scoliosis, the shoulders will not be equidistant from the lens, and the nearer one will appear to be the higher, even though it might actually be the lower of the two.

From personal interviews and medical records Andrews attempted to learn something of the student's environment, habits, and past physical condition—factors which might have had some influential effect on the scoliosis. Various illnesses, accidents, and asymmetrical posture habits which could easily have been causative factors in the development of the lateral curvatures, were revealed, but there was no means of proving the extent of their influence on the existing lateral curvatures.

The most important feature of Andrews' study is the successful demonstration of the fact that the MacEwan objective grading scale can be adapted to the measurement of lateral curves. The procedure is

relatively simple and, except for a skin pencil, calls for no equipment in addition to that needed for the MacEwan method of recording and grading anteroposterior posture.

Now that more satisfactory objective methods of measuring anteroposterior and lateral posture have been developed it might be profitable to pursue the Frost study further. Certainly the problem is of more than academic importance when it is found that about 85 per cent of the students examined at entrance to college have some degree of lateral asymmetry.

The Feet

RUTH Anderson Calvin's "Kinesiology of the Human Foot," (1925) is indeed a splendid piece of work on a subject of considerable importance in physical education. The author's interest in the subject was aroused by observing the prevalence of foot strain in groups of active high school girls. Upon investigation a similar condition was found in men's and women's colleges, among army recruits, and among hospital cases. From the records of the latter it appears that "women's feet are more abused by shoes, and that overweight in proportion to muscular strength is more common among them, while the influence of predisposing occupations is more marked in the male patients." According to one authority quoted by the author, "a foot was considered weak when it showed variations from the normal weight bearing lines with the weight of the body upon it. Foot strain cases were judged by the presence of tenderness at points of ligamentous strain."

In view of the fact that anatomists and kinesiologists disagree among themselves as to the definition of terms used in describing the movements in the foot, and as to the action of the muscles controlling the foot, often omitting certain actions altogether, it was thought advisable to abstract information from various authoritative sources, define terms, and check the findings with experimental work.

The foot is discussed as to general appearance, structure, function, and evolution. Before describing the joints of the foot and the movements permitted by them, the following definitions were agreed upon: adduction and abduction, a lateral motion in a horizontal plane on a vertical axis in the mediotarsal and talocalcaneal joints; inversion and eversion, rotation about an anteroposterior axis taking place in the mediotarsal and talocalcaneal joints; supination, a combination of adduction and inversion; pronation, a combination of abduction and eversion; and toeing in and toeing out, rotations of the thigh which results in a movement of the anterior portion of the foot. In discussing normal bone relationships both in standing and walking, the advantages of the parallel foot position are seen to far outweigh those of toeing out positions.

Careful and extensive experimental studies were made of muscular action. By means of electrical stimulation and radiograph records, the action of individual muscles was determined. Muscular action was also palpated as the subjects performed various movements voluntarily. These results were then compared with the statements made by various authorities. The conclusions are summarized as follows:

A. *Action of individual muscles.*—

1. The *tibialis anterior* produces dorsal flexion, inversion and slight flattening of the arch by moving the first metatarsal obliquely upward and inward.

2. The *extensor hallucis longus* assists in dorsal flexion only when some extension of the great toe accompanies this movement. It may aid slightly in adduction and inversion, but like the *tibialis anterior*, can dorsiflex from positions of adduction and abduction as well as from the intermediate position.

3. The *extensor digitorum longus* produces, more forcefully than it extends the toes, dorsal flexion accompanied by abduction and slight eversion. It cannot act on the ankle joint until it has, partially at least, extended the toes.

4. The *peroneus tertius* assists the *extensor digitorum longus.*

5. The *triceps surae* pulls directly upward on the posterior tuberosity of the calcaneus. The adduction and inversion which accompany the plantar flexion which it produces may be attributed (1) to the configuration of the surfaces if the talocrural and talocalcaneal joints, (2) to the supinators which assist in this movement, especially the *flexor hallucis longus* which passes under the *sustentaculum tali,* and (3) to the pull on the head of the first metatarsal by the *peroneus longus* whose tendon crosses the sole obliquely.

6. The *flexor hallucis longus* assists forcefully in plantar flexion and is a supinator of great importance for the longitudinal arch.

7. The *flexor digitorum longus* assists very slightly in plantar flexion. It cannot be considered a supinator.

8. The *tibialis posterior* is an adductor which assists in plantar flexion. What inversion this muscle produces is due to the fact that the joint surfaces do not permit pure adduction. When the foot reaches complete plantar flexion, further contraction of the *tibialis posterior* produces adduction in this position. When the body weight is on the foot, the *tibialis posterior* can contract with the other internal muscles of the foot to produce supination by a lift of the internal malleolus which rotates the talus so that its head moves outward on the calcaneus.

9. The *peroneus longus* is a powerful plantar flexor, abductor, and evertor, which by its contraction increases the depth of the arch by lowering the first metatarsal, giving it a rotary movement so that its plantar surface looks more outward. Its tendon, passing obliquely across the plantar surface of the foot, lifts the external border. When extreme supination accompanies plantar flexion, the *peronei* cease to contract.

10. The *peroneus brevis* assists in plantar flexion, abduction and eversion.

B. *Muscle analysis for foot movements* (arranged in the probable order of their effective pull in the given movement).—

1. Dorsal flexion—*tibialis anterior, extensor digitorum longus, extensor hallucis longus* and *peroneus tertius.*

2. Plantar flexion—*Gastrocnemius, soleus, peroneus longus, flexor hallucis longus, tibialis posterior, peroneus brevis,* and *flexor digitorum longus.*

3. Pronation—

   a. Eversion—*peroneus longus, peroneus brevis, extensor digitorum longus,* and *peroneus tertius.*

b. Abduction—*extensor digitorum longus, peroneus longus, peroneus brevis,* and *peroneus tertius.*

4. Supination—
   a. Inversion—*tibialis anterior, flexor hallucis longus, extensor hallucis longus.*
   b. Adduction—*tibialis, posterior, flexor hallucis longus, exterior hallucis longus.*

This thesis with its numerous well chosen illustrations has been a most valuable reference to students of kinesiology and paves the way for the further study of foot problems.

Miriam Arrowsmith (1928) continued the work on feet with "A Study of the Feet of One Hundred Girls of College Age, with a Critical Analysis of Subjective and Objective Methods of Grading." All students who were taking special foot work in the individual gymnastics classes were included in the list of subjects. After considerable preliminary experimentation and a careful review of Mrs. Calvin's thesis, the following procedure was decided upon:

1. Obtain photographic records of anterior, posterior, plantar, and lateral views, the latter with and without weight bearing.
2. Grade the following items in a subjective examination: height of the longitudinal and anterior arches, the amount of pronation and flexibility, and the ability to improve the position of the foot; note degree of hallux valgus, standing and walking positions, pain or tenderness, and swelling or heat.
3. Test the strength of the adductor-invertor and the abductor-evertor groups of foot muscles by means of an active pull against a spring balance (Osgood test).
4. Make foot impressions by standing on blotting paper with greased feet.
5. Examine the enlargements of the photographs as follows:

Anterior view—degree of bowing of legs or knocking of knees, incidence of weight line falling from center of the knee, and the amount of toeing out.

Posterior view—curve of Achilles tendon and amount of overhang of internal malleolus (pronation).

Plantar view—hallux valgus, amount of outflare and toeing out.

Lateral views with and without weight—distance from prominence of internal malleolus to horizontal line along sole of foot, distance from prominence of scaphoid to horizontal line along sole of foot, and distance from malleolus to scaphoid. From these measurements the amount of fall of the scaphoid and internal malleolus in weight bearing can be determined.

Certain difficulties were of course inherent in the use of a photographic method and subjective estimates of foot conditions. But making allowances for unavoidable limitations, the author felt that a reasonably satisfactory body of data was collected.

It was evident that feet cannot be graded by considering any one element of structure or function. There seemed to be no significant

relationship between the various signs of weak feet which have been stressed by previous observers. For example, the correlation coefficient showing the relationship between toeing out and pronation as indicated by overhanging malleolus was only .16 which is so low as to be insignificant. It was also found that marked toeing out may be associated with adductor muscles of greater strength than abductors, and conversely, that a habitual parallel position may accompany a preponderance of abductor over adductor strength, or a very low general muscular strength. Pronation and weakness as indicated by a lowering of the scaphoid correlated .03 which is of course insignificant. The correlation between the amount of flare from the mid-line and the ratio of muscular strength was only .22.

The results of the strength tests compare favorably with those obtained by Osgood.[1] For normal feet he reports the ratio of adduction strength greater than abduction strength to be 1.25. The ratios for normal feet in this study ranged from 1.05 to 1.32. The strength ratios tallied remarkably well with the subjective examination of the foot. The fall of the scaphoid and malleolus with weight bearing appears to be a valuable measure. The foot impressions were used only for a rough correlation with a subjective grading and as a matter of general interest to the student.

In Li-Ming Hwang's "Statistical Study Attempting to Develop an Objective Method of Grading Foot Posture" (1931), the following subjective ratings by the instructor in individual gymnastics provided the criterion score:

Anterior arch, maximum 10; deductions: slightly relaxed 1–2, completely relaxed 3–5, prominent 6–10, calloused 6–10, pain 8–10.

Longitudinal arch, maximum 10; deductions: low 3–5, flat 6–8, pain 8–10.

Standing, maximum 10; deductions: toe out 1–3, slight pronation 1–2, medium pronation 3–5, marked pronation 6–10, on heels 1–3.

Toes, maximum 5; deductions: hallux valgus 1–3, crowded 1–2.

Ankle, maximum 5; deductions: limited flexibility 1–2, short tendon of Achilles 3–5.

The objective measurements were made from a series of photographs, pedograph impressions, and caliper readings of the width of the ball of the foot with and without weight bearing.

The photographic technique differed somewhat from that of Arrowsmith. Anterior, posterior, and lateral views were taken with and without weight. For the side views, the head of the first metatarsal and the scaphoid just above its lower border were marked with lip stick. For the back views a short right angle pointer of standard length was placed on the scaphoid point, and the center of the heel was marked. For the

[1] R. B. Osgood, "The Comparative Strength of Adductor and Abductor Groups in the Foot," *Am. Jour. Orth. Surg.* (Oct. 1906); also personal communication.

front views the head of the first metatarsal as well as the scaphoid was marked with a right angle pointer and the center of the anterior aspect of the great toe was marked with lip stick. The measurements made from the enlargements of these pictures were as follows: height of longitudinal arches from side and back views; pronation in terms of the horizontal distance between heel point and base of scaphoid pointer in back view. The measurement of hallux valgus from the toe point to the base of the metatarsal pointer had to be abandoned.

After a preliminary study of pedographs this part of the procedure was abandoned because there seemed to be little correlation between the degree of hallux valgus and the criterion.

The reliability of the objective measurements used is indicated by the high coefficients of correlation between the first series and the second series of tests.

Percentage fall of longitudinal arch with weight, side view, $r = .808$
Spread of anterior arch with weight (caliper measurements), $r = .983$
Pronation increase with weight bearing, back view, $r = .949$

When nine measurements were made on a single subject the variation was approximately 2 per cent.

In the case of 112 undergraduates the correlations of the various objective measurements with the subjective criterion were as follows:

	r	P.E.		r	P.E.
Long. arch—side view			Spread of anterior arch		
Height—without weight	.589	.04	with weight	—.073	.07
Height—with weight	.462	.05	Pronation increase	—.109	.07
Per cent fall with weight	—.204	.06	Body weight	—.015	.07
Long. arch—back view			Hallux valgus		
Height—without weight	.500	.05	(20 cases only)	—.079	.07
Height—with weight	.411	.05	Toes (20 cases only)	.070	.07
Per cent fall with weight	—.247	.06			

For purposes of grading foot posture, the side view photograph is somewhat superior to the back view photograph. Since the height of the non-weight-bearing arch correlates more highly with the criterion than the height of the weight-bearing arch, and since the intercorrelation of these two arch measurements is .857, only the former measurement would be included as a factor in grading. The percentage fall of the arch with weight bearing might possibly be used to build up a multiple correlation coefficient which would have more predictive power than the zero order correlation of .589 alone, but none of the other measures obtained in this study could be so used because of the low correlations with the criterion.

The Lower Back

THE three Wellesley College studies on the subject of the lower back are as follows:

Pelvic Obliquity: Its Measurement and Importance in Physical Efficiency, M. Esther Shaw, '28.

An Investigation Into the Causes of Back Pain, Enid Schnauber '30.

A Study of the Bony Variations and Interrelations of the Last Lumbar Vertebra and Sacrum, Mary D. Bigelow '34.

According to Shaw, it has been generally assumed that marked variation in the tilt of the pelvis in either direction from the "normal" angle may be accompanied by characteristic symptoms such as dysmenorrhea, constipation, low back pain, and decreased efficiency. When the obliquity of the pelvis is increased, a large proportion of the weight of the abdominal organs is supported by the lower abdominal wall, the forward shearing stress in the lumbosacral joint is increased, and (according to Schurmeier, *American Medicine,* March, 1927) there is a greater percentage of serum albumin in the urine, a fact indicating a relationship between this type of poor posture and malnutrition. Conversely, decreased pelvic inclination tends to wedge the ilia apart, more weight is directed toward the pelvic viscera, and the support of the anteriorly placed chest load is less effective because of the accompanying decrease in lumbar lordosis. Recently criticism has been directed against the "straight" lower back and accompanying "horizontal" pelvic position as being even more disadvantageous for women than the exaggerated hollow back which it seems to have superseded in fashion.

In order to determine the optimum range of pelvic obliquity and to confirm the alleged ill effects of tilt outside this range, a simple but adequately precise method of measuring the obliquity of the pelvis is needed. The object of Shaw's study was to try out various methods and see how they correlate with each other; also to determine the relationship between the degree of pelvic obliquity and dysmenorrhea.

Significant landmarks on the bony pelvis are the upper border of the *symphysis pubis,* the upper surface of the sacrum which articulates with the body of the fifth lumbar vertebra, and the anterior superior iliac spines, as shown in Fig. IV. The internal conjugate diameter of the pelvis is the distance from the symphysis to the anterior border of the upper surface of the sacrum (AA^1). The external conjugate diameter (BB^1) is the distance from the symphysis to the end of the spinous process of the fifth lumbar vertebra.

Pelvic obliquity may be measured in terms of the angle made by

these diameters with the horizontal, or by the angular deviation of the line joining the symphysis and the anterior superior iliac spines (CC^1) from the vertical through the symphysis.

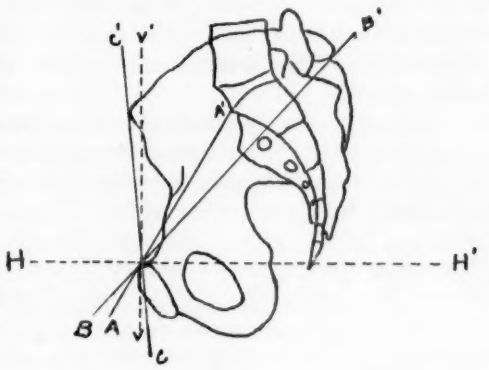

FIG. IV. Construction lines for measuring obliquity of the pelvis.

Most writers on the subject agree that in the normal erect position the anterior superior iliac spines and the symphysis are in the same vertical plane. If the spines are anterior to the symphysis the angular deviation is said to be positive; if they are posterior to the symphysis the deviation is said to be negative. Positive angular deviation is associated with increased pelvic obliquity. Lumbar lordosis is also generally thought to be related to the pelvic obliquity. The following five measures of pelvic obliquity were therefore made on an unselected group of Wellesley College undergraduates (99 subjects):

1. Angular relationship of external conjugate diameter with the horizontal was read directly from a clinometer (calipers with protractor attachment and plumb bob), one arm of the calipers being placed on the *symphysis pubis*, the other at the end of the spinous process of the fifth lumbar vertebra.

2. Angular relationship of external conjugate diameter with the horizontal was computed with the help of trigonometric tables from the following data: difference in height of *symphysis pubis* and end of spinous process of the fifth lumbar vertebra, and horizontal distance between these two points.

3. Angular deviation of the anterior superior iliac spines from the vertical plane of the symphysis computed from the difference in height and the horizontal distance between the two points as in (2).

4. Depth of lumbar curve from straight edge placed against dorsal spine and sacrum.

5. Depth of lumbar curve from plumb line with the bob touching the sacrum at the cleft of the buttocks.

The results show an average inclination of the external conjugate diameter of about 38° with a standard deviation of about 3°, a negative angular deviation of the anterior superior iliac spines of 9°, and an average depth of 4 cm. for the lumbar curve.

In 80 per cent of the cases the anterior superior iliac spines were posterior to the vertical plane of the symphysis, in only one case were

they in the same plane, and in the remaining 19 cases they were in front of it. This and the rather low average for the inclination of the external conjugate diameter indicate a tendency toward a decreased pelvic obliquity.

There was a fairly good correlation between the angles of inclination as measured by the clinometer and by trigonometric computation (.713), but the coefficients with the other measures were much lower as can be seen in the following table.

Correlation of clinometer readings with	*r*	P.E.
Computed obliquity of external conjugate	.713	.03
Deviation of anterior superior spines	.389	.06
Lumbar depth from straight edge	.422	.05
Lumbar depth from plumb line	.251	.06

Study of the reports on dysmenorrhea showed the following differences in the groups classified according to the degree of pelvic obliquity.

Degree of Pelvic Obliquity	Dysmenorrhea Report	
	Little or none	Moderate or severe
20° to 30°	71.5	28.5
30° to 40°	75	25
40° to 50°	73	17

Schnauber's study on back pains begins with a résumé of the literature and theoretical considerations before proceeding with the experimental work. From the literature it appears that faulty body statics is a common cause of back pain. Round shoulders, hollow back, sway back, prominent abdomen, and pronated feet are examples of faulty postural relations which may produce chronic strains and give rise to back pain.

In all erect positions of the body, the segments should be so placed as to make possible a favorable distribution of the superposed load. In general the weight should be carried by the bones and not by muscles or ligaments. The weight bearing column of the spine is made up of the vertebral bodies and intervertebral discs. The columns made up of the articular processes are not physiologically adapted to weight bearing although they may assume this function in certain positions of the spine. If this does occur, the spine loses part of its resiliency.

The points of potential weakness in the spine and pelvis are the dorsolumbar and lumbosacral junctions and the sacroiliac joints. The dorsolumbar junction lacks rib support and permits relatively free movement. The lumbosacral junction lacks mechanical stability because of the inclination of the supporting surface of the body of the sacrum (about 45° in the normal position). To maintain its position on this

slope, the fifth lumbar vertebra is slung between the iliac crests by the iliolumbar ligaments. The superior articular processes of the sacrum are the only bony block against forward slipping of the fifth lumbar vertebra on the sacrum. As the obliquity of the pelvis is increased, more weight is suspended by the iliolumbar ligaments and less is carried upon the sacrum. The sacroiliac joints have little motion but are quite efficient as shock absorbers. The sacrum is slung between the two innominate bones by the strong posterior sacroiliac and sacrosciatic ligaments in such a way that when the top of the sacrum is pushed downward and forward by the weight of the body transmitted through the spine, the innominate bones are drawn tightly against the sacrum. The lumbosacral and sacroiliac joints are dependent upon each other for the proper support of body weight; yielding of one of these puts additional strain upon the other.

Steindler states that static disorders are often found in long narrow backs in which the lumbar spine is set up high so that the sacrum is of greater length than the normal, in cases where the lumbar spine is flat and generally endowed with poor musculature, and in cases of marked lumbar lordosis.[1] Under normal physiological conditions relaxation of the ligamentous structures occurs only occasionally as during pregnancy or menstruation, but there may be ligamentous relaxation under the influence of general debilitating conditions.

When the foot is pronated or sags inward there is an inward rotation of the whole leg and consequent stretching of the external rotator muscles of the hip joint. This induces strain both in the foot and hip joint, and the person is apt to walk with a gait which has lost its spring.

Schnauber's subjects were fifty-four students entering Wellesley College in September 1929 who complained of back pain, particularly at the menstrual period, and an unselected group of a hundred students who made no complaint of back pain.

Each of the girls who had a record of back pain was interviewed as to when and where the pain occurred, its nature and duration, and how it was relieved. The pain was usually a dull ache, located in the sacrolumbar region. It occurred most often at the menstrual period and toward the end of the day. Lying down usually relieved it. MacAusland calls attention to the fact that the threshold to pain is lowered during the menstrual period.

Postural relations for the 154 cases were measured on a series of profile pictures of habitual standing position taken by MacEwan for use in her study of posture grading. A series of light aluminum pointers marked the spine from the seventh cervical vertebra to the sacrum, and there was one pointer just above the xiphoid on the sternum. Enlargements of these pictures were made on coördinate paper, the

[1] Arthur Steindler, *Diseases and Deformities of the Spine and Thorax*, (1929), p. 313.

plumb line in the picture corresponding with the vertical lines of the coördinate paper. A vertical line (*ab* in Fig. V) was erected from the proximal end of the fifth metatarsal bone in order to establish a plane of reference for other measurements. Further points in the procedure were as follows:

1. The distance *k* from the mid-point of the knee to *ab* was measured to give the relative position of the knee.

2. The horizontal distance from *ab* to the front and back of the body profile at the level of the sacral pointer was found (*f* and *e* on the diagram). The distance from *ab* to the back divided by the distance in front shows a ratio of weight distribution. When the quotient is unity, the weight is equally divided. When it is less than unity, the larger share of the weight is carried forward.

3. The mid-points between the front and back at the level of the sacral and sternal pointers located the line *xy*. The angle made by *xy* with the horizontal was measured to give an index of the tilt of the trunk. The level of the seventh cervical vertebra was considered for the upper point, but it was found to be too much influenced by the position of the head.

4. An angular measure of weight distribution was made by connecting the mid-point at the level of the sacral pointer (*x*) with the proximal end of the fifth metatarsal (*a*) and measuring the angle made by the line *ax* with the horizontal. This measure was discarded in favor of the ratio found in (2) when the intercorrelation was found to be .879.

5. The point of change of curve on the outline of the back as shown by the divergence of the outer ends of the pointers (*d* on the diagram) was connected with the base of the seventh cervical pointer (*dc*) and with the base of the sacral pointer (*ds*). The depths of the dorsal and lumbar curves were measured horizontally from the lines *dc* and *ds*.

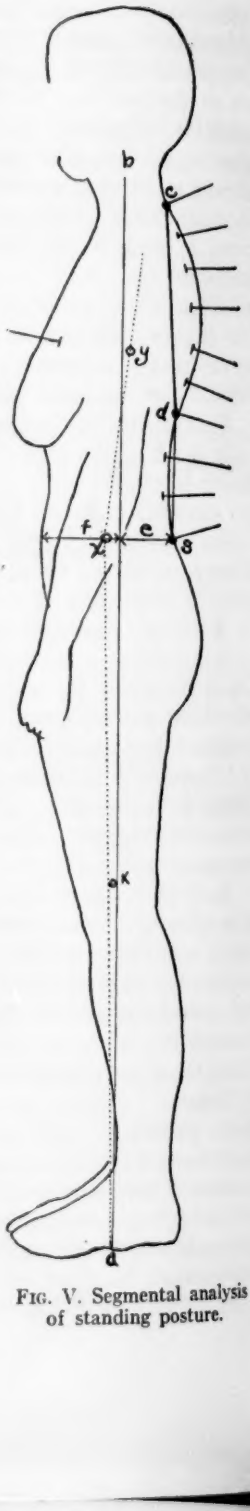

FIG. V. Segmental analysis of standing posture.

The above measurements were made for purposes of comparison rather than for their absolute values.

Lowman's measure of pronation (*Corrective Physical Education for Groups*, p. 75) was made on students in the back pain group as follows: The prominence of the scaphoid was marked with a soft pencil. Then a straight edge was placed connecting the middle of the internal malleolus with the prominence of the great toe. The perpendicular distance from this line to the floor at the location of the scaphoid, and the distance of the scaphoid from the floor were measured. The difference between the two measurements was recorded as the distance the scaphoid had descended. The results correlated .855 with the clinical findings concerning the degree of pronation (slight, medium, and marked), and this seemed to warrant the use of the clinical findings in all cases.

The comparison of pronation in the two groups of subjects shows that back pain and pronation tend to go together. The percentages for the normal and back pain groups were as follows:

	Degree of Pronation			
	None	Slight	Medium	Marked
Normal	41	37	10	12
Back pain	4	48	26	22

The two groups are surprisingly alike with respect to range and distribution of measurements of knee position, weight distribution, trunk angle, and depths of thoracic and lumbar curves. None of these characteristics serves to distinguish one group from the other, although in the back pain group the knee point average was 1.2 mm. back of the average for the normal group; the average body tilt backward is 1° greater for the back pain group; and the same is true of the depths of the thoracic and lumbar curves. The range of weight distribution ratios is much greater in the back pain group and the average ratio indicates that the weight is carried slightly more to the rear.

Perhaps it is a complex of postural relationships rather than any single factor that is significantly related to back pain, but such a back pain "syndrome" was not evident from this study of possible factors. Following Steindler we recognize that posture as a physiologic state must be given some latitude, and that individual variations may swing back and forth and yet be within the normal limits. It is in the last analysis a question of proper body balance and the ability of the structures to meet successfully the mechanical demands made upon them.

Bigelow's thesis "A Study of the Bony Variations and Interrelations of the Last Lumbar Vertebra and Sacrum" will be reported in part in

the May, 1938 number of the RESEARCH QUARTERLY. One hundred and fifty-seven skeletons were examined at the Hamann Museum of Western Reserve University. Bigelow's contribution lies in the definite picture she gives of the lumbosacral junction, the evidence of its innate architectural weakness, and the prevalence of anomalies likely to influence stability and motion in this phylogenetically unstable region of the skeleton. Her thesis is profusely illustrated with camera lucida drawings.

Body Type and Weight Prediction

IT HAS long been recognized that individuals and racial groups differ in body dimensions and in the relation these dimensions bear to each other; also that optimal body weight is a signifiant index of physical condition. Although body type is largely a matter of heredity, environmental conditions of climate, food, and occupation, acting over long periods of time, are reflected in body measurements. The skeletal system is less influenced by these environmental factors than the soft tissues. It has long seemed profitable, therefore, to study the relation of body weight to bony frame in individuals who are considered to have good nutritional status. The next step is to set up valid standards of normal weight in terms of relatively stable body measurements. The four thesis studies on this subject are as follows:

A Study of the Relation of Certain Skeletal Dimensions to Body Weight in 1,030 Women of College Age, Marian M. Johnson '24.

The Relation Between Certain Skeletal Measurements and Body Weight in 500 College Women, Marie Manchee '30.

The Specific Gravity of the Human Body; An Approach to the Analysis of Body Weight into Muscle, Fat, and Bone Quotas, Mary B. Davies '30.

A Study of Body Type and Its Relation to Normal Weight, Katherine E. Doyle '31.

Johnson (1924) dealt particularly with the relation of chest volume to other body measures. An empirical formula was worked out for getting chest volume from measurements of chest depth, chest width, and trunk height. Measurements on X-ray pictures of fifteen subjects ranging from very thin to moderately obese showed that there is a variable difference between external caliper measurements and actual skeletal dimensions. Differences in width due to skin and subcutaneous fat ranged from 0.34 to 3.45 cm. with an average of 2.07 cm., while differences in depth varied between zero and 3.22 cm. with an average of 1.30 cm.

Among subjects judged to be in good nutrition, *chest volume* correlated .734 with *weight*. The coefficients for *chest volume times height*, and *chest volume times height squared* were .808 and .794 respectively. Either of the chest volume indices, therefore, were considered fairly satisfactory for predicting weight. This method was found to be better than the Dreyer method, but not as effective as the actuarial standard (height-weight-age tables) in selecting the extreme cases of over- and underweight.

Manchee (1930) measured the height, weight, chest depth at the limit of inspiration and expiration, breadth of both wrists, and breadth of both ankles of 500 entering students at Wellesley College. In 200 of the 500 cases, the thickness of skin and subcutaneous tissue were also measured. The subjects were classified as to type by computing the ponderal index and by subjective ratings of profile posture pictures.

By means of partial correlation technique, the relationships of the factors measured were studied for the group as a whole and for the slender, medium, and stocky types. For the group as a whole, the zero order correlations were as follows:

	Weight	Height	Wrist Breadth	Ankle Breadth	Chest Depth
1. Weight	...	.446	.497	.480	.611
2. Height	.446	...	.444	.459	.165
3. Wrist Breadth	.497	.444	...	.622	.355
4. Ankle Breadth	.480	.459	.622	...	.293
5. Chest Depth	.611	.165	.355	.293	...

From the coefficients of partial correlation it appears that there exists a very high relationship between chest depth and weight which is little affected by other factors. Wrist and ankle breadths affect other variables to an equal degree and have a high correlation with each other. For these reasons one of these two measurements could be eliminated from the predictive formula. The multiple coefficients of correlation, indicating the relationship between actual and predicted weights, show that wrist breadth, ankle breadth, or both may be eliminated without lowering the predictive value a great deal.

Variables	R	Variables	R
1(2345)	.733	1(235)	.724
1(245)	.727	1(25)	.704

From this it can be seen that chest depth is much more important in the prediction of body weight than any of the other measurements; also that height and chest depth together give a very satisfactory multiple correlation (.704).

Objective measures of body build were obtained as follows: (1) ponderal index—the cube root of the weight in kilograms divided by the height in centimeters and multiplied by a thousand, (2) vital index —chest depth divided by height times a hundred, and (3) bone size index—wrist-ankle average divided by height times a hundred. The relationship between these objective measures of body build were as follows:

Ponderal Index and Vital Index	.653
Ponderal Index and Bone Size Index	.432
Bone Size Index and Vital Index	.353

These results are somewhat comparable to those obtained by

McCloy for 483 Chinese college men.[1] His correlations with ponderal index were as follows:

Vital Index (mean chest girth x 100/total height)	.820
Bone Size Index (100 x sum of breadth at elbow, wrist, knee, and ankle/total height)	.426
Stature Index (100 x sitting height/total height)	.209

The ponderal indices obtained by Manchee were related to the measures considered for use in the weight prediction formula as follows:

Weight	.632	Ankle Breadth	.136
Height	.121	Chest Depth	.511
Wrist Breadth	.136		

The measure of thickness of skin and subcutaneous fat was significantly related to body weight (.569), to ponderal index (.574), and to the difference between actual and predicted weights (.306).

Davies (1930) raises the question of the physiological significance of conforming to a so-called "normal" weight when this means, in general, merely the average of fat quota for height or frame.

The one hundred subjects used by Davies were selected as far as possible to cover a wide range of body type: tall-thin, short-thin, short-heavy, and tall-heavy. The measures taken were: specific gravity of the whole body, weight, height, vital capacity, chest depth at the level of the junction of the third rib with the sternum, diameter of wrists and ankles, thickness of skin and subcutaneous fat, and strength (Martin short test). Specific gravity was computed from body weight and the corrected volume of water displaced by complete immersion during maximal inspiration. To eliminate lung space, two corrections were applied: vital capacity, and mean residual air. The Martin strength index was obtained by dividing total strength by pounds of body weight.

The relation of these various factors to specific gravity is indicated by the following coefficients of correlation:

Weight	—.515	Wrist-ankle average	—.136
Predicted Weight	—.362	Height	—.101
Ponderal Index	—.620	Vital Capacity	.186
Skin and Fat	—.598	Vital Index	.231
Chest Depth	—.320	Muscular Strength	.437

There is a definite trend from the heavy people with a low specific gravity to the light-weight people with a high specific gravity. Since fat is the only tissue whose specific gravity is less than one, it follows that the ascent of the weight distribution scale is usually not accomplished by a proportionate increase in bone, muscle, and fat, but by a

[1] C. H. McCloy, "Weight Standards for the Individual," *A.P.E.R.*, 24 (Sept. 1926), p. 920.

disproportionate increase in fat. It is noteworthy that the inverse relation of ponderal index and specific gravity is even greater than that between specific gravity and weight. The short person with a high ponderal index is more likely to be buoyant (probably because of a more generous allowance of subcutaneous fat) than the taller person of the same weight or even of somewhat greater weight. The relative amount of fat as measured on the forearm, shoulder, and abdomen seems to be an important factor in determining specific gravity.

We are prone to think of stockiness in terms of heavy masses of muscle knitting closely together a broad low skeletal architecture, encumbered by a minimum of subcutaneous fat. But the specific gravity evidence seems to indicate a general tendency for stockiness to be characterized by adipose rather than muscular abundance. The strong people (strength per pound weight) are those with a high density. This fact is further evidence that variation in weight is accompanied by a changing ratio of muscle to other tissues, and not by a proportionate change in the amount of all tissues. The lack of correlation between any skeletal measurements and specific gravity shows convincingly that it is the character of the soft tissue of the body (i.e., the relation of fat to muscle), and not the size of the bones which determines its density. In other words, bone like muscle has a virtually constant density, and variation in its volume, since it is accompanied by a proportional variation in its weight, cannot in itself produce a change in specific gravity of the body as a whole. Since, in general, muscle and bones (with their provisions for muscular attachments) are in constant ratio, it follows that variations in specific gravity are due to the variations in the relation of fat to other tissues, and not to variations within the tissues themselves.

The conclusions then are that specific gravity is a function of the ratio of fat to bone and muscle; that differences in body type and weight tend to be characterized by corresponding differences in this ratio; that excess weight according to Manchee's prediction formula, is in the form of subcutaneous fat; that specific gravity is not significantly correlated with vital capacity or vital index; and that skeletal dimensions per se have no influence on the specific gravity of the human body.

Doyle (1931) determined the volumes of various parts of the body. She also obtained data as to certain bony measurements, over-all circumferences, and the thickness of subcutaneous tissue. Body type was judged from profile posture pictures. Various measures were found to correlate with the subjective estimate of body type and with body weight as follows:

Body Type	r	Weight	r
Weight	.559	Volume Below Iliac Spines	.884
Ponderal Index	.786	Arm Volume	.848
Chest Girth	.574	Arm Girth	.677
Height	−.067	Arm Length	.620
Arm Volume	.328	Wrist Breadth	.232

Since girths and volumes measure the same quality as body weight, namely, the amount of body substance, their usefulness in weight prediction formulae is questioned.

Granted that the ordinary height-age tables are unsatisfactory for determining the "normal" weight of college women, what better method is recommended? The most practical answer in terms of this group of research projects is Manchee's formula for predicting body weight from height and chest depth. However, in view of other recent work in this field, it seems desirable to make a rather extensive study of hip and chest widths as well as chest depth and standing height. A project is now under way in which such measurements upon college women have been made in various parts of the country (2000 subjects all told). The purpose is to develop if possible a valid, reliable, and practical method of weight prediction for college women.

Movement in Representative Art

THIS thesis by Margaret L. Krolik was done in 1931 under the supervision of the Department of Art. It is presented here (with permission) because the principles described and analyzed are applicable to dance, and because part of the thesis problem consisted in the collection and selection of sources in art for the dance drama, "Chorus Aeternus," developed by the students of dance, under the direction of Charlotte MacEwan of the Department of Hygiene and Physical Education.

In its sound development of the past ten years, creative dance is the most valuable single linkage between the physical aims of physical training and conditioning, on the one hand, and the broad field of cultural development on the other. With the representative arts of drawing, painting, and sculpture especially, it has some of its closest points of contact.

Krolik analyzes and illustrates these points of contact and relationships, emphasizing the sense of *movement* inherent in these arts. In her introductory chapters, she outlines the kinesiology of motion in the body, the physiology of movement and action, and the living tone (subliminal movement so to speak) which distinguishes inertness and life, even in an object at rest. The "pregnant movement," she quotes, is that chosen by the artist as best suggesting to the mind's eye and kinaesthetic association the flow of movement preceding and succeeding that moment. Its correct selection marks the difference between a work of art having movement and one that is dull and fixed—between a snapshot in photography that appears to be "on the go" and one which appears to be posed.

A discussion is given of rhythm devices, such as the repetition of similar lines or patterns. Balance (which may be symmetrical or unsymmetrical) is "an adjustment between opposing forces or attractions, such as those of lines, outlines, tones, or movements which result in stability or equipoise."

Distortion may occur because anatomy is forgotten by or unknown to the artist, or it may be deliberate. In the first cases the sense of movement may exist in spite of it. In the last case, the sense of movement may be greatly enhanced.

Other means by which the sense of movement may be stimulated are progressions, gradations, continuations of tone, mass, and line, by which the attention of the beholder is directed and led.

"Line" in art may be "structural," "contour," "directional," or "functional." It is the functional line that is prepotent. "The line in a

great drawing is not the slave to anatomical arrests or beginnings. There is a line that runs right through the pointing arm and finger tips into space. This is the line which the artist draws and makes you follow. ... Your eye does not follow the muscle and bone of the arm. It follows the spirit of life in the arm." It is supplemented by the poise of the body and the "focus" of the organs of visual attention.

The emotional effects of line are multifarious. In general and very simply, verticality connotes stability; horizontality, repose. The diagonal line is most active.

Following the introductory analysis, so briefly noted here, there is an exemplification and discussion, through selected art forms—Paleolithic, Egyptian, Mesopotamian, Aegean, Greek. This section is profusely illustrated with 75 plates and illustrations.

The last part of Krolik's thesis is devoted to an exposition of how movement in representative art may be translated into actual movement in dance art. The best way of reporting this is to quote from the program notes of "Chorus Aeternus." It will be noted that whereas the thesis ends with Greek art, the drama itself carries the parallel through to modern times.

Chorus Æternus implies the unending cycle of dance forms as represented in art from the earliest ages down to the present century. For the most part the subjects of the episodes are derived from specific examples in painting, mosaics, sculpture or minor arts. The whole is to be looked upon not as an attempted historical reconstruction of the Dance itself, but as an interpretation in dance form of the movement and spirit characteristic of some of the most important epochs in the history of art.

1. Acrobatic Dancers. Egyptian—ca. 2000 B. C. Mural paintings in a tomb at Beni-Hassan.

The movements in Egyptian art were formal and angular due to the convention of representing the human figure with head and legs in profile and shoulders in front view. The actions of the figures were often vigorous; nevertheless the most violent gestures were tempered with firmness, emotional restraint and cultured leisure. *Verdi.*

2. Priestesses Worshiping the Snake Goddess. Aegean—1500 B. C. Signet rings.

Aegean art was imbued with a sense of lively motion as shown in scenes of bullfights and boxing; but in representations of processions or ritual the action of the figures became dignified and formal, differing from Egyptian movement in an additional freedom and a slight acceleration. *Bach.*

3. Sileni. Archaic Greek—6th Century B.C. Black-figured vases.

The black-figured style of vase painting was characterized by an angularity of movement which was no longer stiff, but sprightly and staccato. The motions of arms and legs were of primary importance, and the flexed elbows, hips and knees produced combinations of humorous and grotesque attitudes. *Grieg.*

4. TABLEAU. Greek—5th Century B. C. Frieze of the Parthenon.

The movement in the greatest art of the Golden Age of Pericles was so monumental and sculpturesque that it does not lend itself to transformation into another medium of art expression. *Gluck.*

5. BACCHANTE. Roman—1st Century A. D. Bas-reliefs.

In the best monuments of the Augustan Age the movement retained the continuity and rhythmic flow of line, the sweeping gestures and the freedom yet purity of emotional expression that was its inheritance from Greek art. *Debussy.*

6. PROCESSION OF SAINTS. Italo-Byzantine—6th Century. Mosaic in S. Apollinare Nuovo, Ravenna.

Processional compositions at Ravenna in the sixth century were influenced by oriental predilection for magnificent pattern and ornamental splendor. The movement, subordinated to the decorative scene, became stiff, and the frontal position was maintained. *Bach.*

7. THE CRUSADER. French Gothic—1220. Jamb-Figure: *S. Theodore,* Chartres Cathedral.

It is interesting to note that in two of the greatest periods in the history of art, the Fifth Century in Greece, and the Thirteenth Century in France, the movement was so simple, disciplined, and effective that it can not be translated into another mode of expression without diminishing its true character. *Grieg.*

8. THE LAST JUDGMENT. Late Gothic and Early Renaissance—14th and 15th Centuries.

a. Hell. Paintings by Jaume Serra: *Hell Mouth* and *The Last Judgment.*

The gestures of the devils are animated and amusing, but not broad or rhythmic. *Richard Strauss.*

b. Paradise. Paintings by Fra Angelico: *The Last Judgment.*

The movements of the angels are free, but marked by a gentle restraint and sweet simplicity. *Richard Strauss.*

9. DANCING CHILDREN. Renaissance—Early 15th Century. Relief from Donatello's *Cantoria.*

The rollicking spontaneity, the gay-hearted naiveté of merry children are expressive of the *joie de vivre* of the Renaissance. Laughter and freedom were the pass words of the age. *Smetana.*

10. IMPRESSIONS. Baroque—17th Century. Paintings by Ribalta, Ribera, Zurburan, Murillo, and Rubens.

a. Dramatic. b. Sentimental. c. Violent. d. Tumultuous.

In the seventeenth century art shook off all rational restraint. Motion was accelerated until it reached a height of exaggerated speed marked by operatic intensity, frantic confusion, and melodramatic emotionalism. *Grieg.*

11. EMBARKATION FOR CYTHEREA. French—18th Century. Painting by Watteau.

The emotional restlessness of the seventeenth century was followed by an age of aristocratic elegance and sophisticated simplicity. Sentimentality became coquetry, and violence, playfulness. The dramatic instinct was expressed in pompous splendor and showy pageantry. *Beethoven.*

12. A DANCING LESSON. French—19th Century. Paintings by Degas: Ballet Girls.

In the work of this late nineteenth century master, movement became stereotyped and artificial, motivated less by an interest in expressing ideas or emotions than by a purely intellectual desire for pattern. A spirit of realism and satire affected his art. *Brahms.*

13. HARLEQUINS. Cubist—20th Century. Paintings by Picasso and Légier.

The early twentieth century carried the intellectual impulse of the nineteenth century to its logical conclusion. Movement and form based on orderly dimensional concepts were discarded. Figures were built in multiple planes and emphasis was placed on abstract geometrical structure. Actions were directed not by natural impulse, but by the mathematical and decorative needs of composition. *Albeniz.*

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